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FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

FIRE CONTROL NOTES

Number One of a Series of Publications Devoted to the

TECHNIQUE OF FIRE CONTROL

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THE FOREST SERVICE—U. S. DEPARTMENT OF AGRICULTURE

DECEMBER, 1936

The value of these publications will be determined by what you and other readers contribute. Something in your fire control thinking or work would be interesting and helpful to others. Write it up and give other men some return for what they have given you.

Articles and notes are wanted on developments of any phase of Fire Research or Fire Control Management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting methods or reporting, and statistical systems. Whether an article is four lines or ten typewritten pages in length does not matter. The only requirement is that articles be interesting and worth while to a reasonable proportion of readers.

Address DIVISION OF FIRE CONTROL
FOREST SERVICE, WASHINGTON, D. C.

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FIRE CONTROL NOTES OFFERS ITS SERVICES

Roy Headley
Forest Service, Washington, D. C.

The Fire Control Meeting at Spokane, Washington, in February, 1936, gave the Forest Service Division of Fire Control in Washington, D. C., a mandate to issue from time to time a publication which would serve as a medium for exchange of information and ideas between all the groups and individuals who are doing creative work in forest fire control. On the assumption that readers will respond with ideas and information to publish, the mandate is accepted.

Over a period of 30 years since the inception of organized effort to stop the fire waste of American natural resources, impressive advances have been made. Considerable body of knowledge of the arts and sciences involved has accumulated. Systems of organizing and managing human forces and mechanical aids have in some instances attained dramatic efficiency. Fire research has won the respect of owners and managers of wild land. The advancement to date in technique entitles fire control to a place among the amazing technologies which have grown up in recent decades.

The advance of the technology of forest fire control is not, however, a completed thing. Its forward march has not even begun to slow down. On the contrary, there is good reason to anticipate a period of broader and more rapid growth. Fire control has won a large measure of public interest. Its relation to conservation of wild land resources is better understood. Financial support is increasing. A growing number of men are making technical contributions from a wider range of ability and training. More men know more about how to climb to new plateaus of efficiency in stopping this fire waste.

Future advances will come not from the work of small groups, but from the experience, thinking, and experiments of the large number of men now engaged in pushing back the frontiers of fire control. The integrated experience and study of such a body of interested men may easily yield results overshadowing all that has been gained so far.

The surprising thing is that the need for a vehicle for interchange of ideas among such men has not been recognized before. Widely scattered as they necessarily are, the creative efforts of individuals and separate groups cannot be fully effective without the aid of something which will serve as a common meeting ground, a clearing-house of developments. Fire Control Notes aspires to render that service. It hopes to be a carrier of whatever men need to know to keep abreast of developments and trends in fire control.

Fire Control Notes will seek to act as a channel through which useful or suggestive information may flow to each man in this field, whether he be a fire research worker attacking some fundamental of combustion, or a fire fighter, facing the flame and smoke, who discovers some new device for organizing a crew of laborers. These pages will also hope to be used as a mouthpiece for every man, whatever his job, who discovers something which would be useful to others, or who has a criticism to make, a question to raise, or an unusual fire experience to relate.

As implied by the name, "Fire Control Notes," it matters not how long or how short a contribution may be nor what angle of fire control is presented. The man who discovers some new device which can be presented in four lines owes it to himself and others to report it. Likewise, the fire research man who needs ten pages for a worthwhile presentation of his subject should share what he has learned with others who need his help or who may be needed to supply the intelligent interest required to sustain the inquiry.

The only requirement imposed upon contributions to Fire Control Notes is that they be interesting or helpful to some group of people concerned with some phase of fire control.

Fire Control Notes will be published intermittently as contributions accumulate. Distribution will not be limited to members of the Forest Service, but will include all who are cooperating with it in stopping forest fire waste. Copies will be sent to State forest organizations, cooperative protection associations, forest schools, Federal bureaus interested in fire control, and Canadian and other foreign organizations dealing with fire problems. Within reasonable limits, any individual who is not included in the organizations mentioned may be placed upon the mailing list by agreeing to constitute himself or herself a committee of one to discuss with friends the need for habits of care in the use of fire. Leaflets and other printed material may be obtained upon request for use in such discussions.

AERIAL AND CHEMICAL AIDS

DAVID P. GODWIN
Forest Service, Washington, D. C.

The concept that forest fires can be successfully retarded or extinguished by chemical treatment from the air has been a wishful thought, since there is no built-up knowledge of possible techniques. There has been some research in the field of fire-retarding chemicals and some attempts to drop free water from a plane, but no promising recorded experience.

As a result of consideration at the Spokane Fire Control meeting in February, 1936, a decision was made to conduct studies of such thoroughness and duration as to get to the bottom of these subjects, and, if possible, build from them techniques to supplement our established suppression methods.

From the first it has been necessary to maintain a clear distinction between the chemical project and the aerial project. The former sets out to discover or develop effective chemicals and their mechanical application in fire suppression, whether such application be on the ground or from the air. The latter seeks to develop aerial technique for the fire-retarding application of not only chemicals, but water and explosives.

The chemical studies, as planned, cover the whole wide field of possible fire-suppressive chemicals. Following the Spokane meeting it was realized that that particular segment of the chemical field known as "fire foams" was an established practice in oil and urban fire suppression, and therefore was not so much a matter of study and research as one of adaptation. The proposed fire foams experiments were therefore detached from the general chemical project, which had been assigned to the Branch of Research, and was retained by the administrative Division of Fire Control.

The Branch of Research turned over to the Madison Laboratory the direction and conduct of the general chemical project, and that work is proceeding quite independent of the fire foams project.

The fire foams project is being conducted on the Monongahela National Forest in West Virginia and at the Philadelphia plant of a chemical company specializing in fire extinguishing materials. This corporation is proceeding under a cooperative agreement with the Forest Service, and two of its members most experienced in the chemical and mechanical aspects of the work have been appointed by the Department as collaborators.

The primary emphasis with both chemical projects will be upon the development of chemicals for use in our fire suppression activities on the ground. If either project in the course of this work develops chemicals or

containers or other applying devices suitable for aerial use they will be passed on to the aerial project for tryout in the air.

The aerial project had been planned for Region 1, but various unavoidable delays so shortened the season that the work center was shifted to Region 5, where the work is now in progress.

A discussion at this time of any of these projects can be merely a progress report—and a meagre one at that—since actual work was not started until September and has been exploratory and groping.[1]

Fire Foams Project

Fire foams, as generally known, are created by the mixture of two chemicals (sodium bicarbonate and aluminum sulphate), plus a stabilizer, or bubble former (such as extract of licorice root), brought into contact with water. These component parts vary slightly with the several manufacturers, but the general foaming effect is about the same. The volume of foam produced is about eight times the volume of water used.

Three methods of mixing are used in present practice, and for forest work it has been necessary to select the most effective method for the kind of application desired. The methods are:

1. One powder method—All dry chemicals are mixed together in advance and fed into one hopper above the generator, through which a single stream of water is passing.
2. Two powder method—Compound A (aluminum sulphate) and compound B (sodium bicarbonate plus the stabilizer) are fed into separate hoppers and meet as two solutions.
3. Two solution method—Compounds A and B are separately mixed with water and held in solution in storage until mixed, as with hand extinguishers.

For use with pumper and hose lines, and with tank trucks, the one powder method has been adopted as the simplest and best suited to our conditions of transportation.

For use with the back-pack rig, mixing of dry powder with the water stream is not feasible, and the two solution method has been adopted.

For use with aerial bombs, dry powder cannot be mixed quickly enough with water, so that the two solution method has been used.

In the control of fires in oil or other flammable liquids, the smothering effect of foams is the result sought. Apparently, therefore, little attention has been given in the industrial field to the possible addition of flame-

[1]During the progress of the early foam studies, and in the course of the foam experiments, many ideas, designs, and models for aerial foam containers and devices were developed. Some of these were tested in Philadelphia and West Virginia and some were passed on to the Aerial Project in California. This latter project, however, has had so short a time to find itself that discussion in this issue would be premature and could deal only with preparatory activities in flying and bombing technique. It will be covered more fully in the next issue.

retarding chemicals. For forest fuels, however, it has been recognized from the start that though we would get cooling and smothering effects from the wet foam itself, we should have some gas more potent than carbon dioxide held in the tiny bubbles. Through the knowledge and experiments of our collaborator, G. G. Urquhart, the foam compounds have been fortified or "loaded" with various flame-retarding chemicals and will be put under comparative field tests. The "load" used on the first Monongahela tests was ammonium sulphate, but others, such as sodium acetate, magnesium chloride, zinc chloride, and ammonium bromide, will be tried out in the future.

Considerable preliminary work was done at the plant of the chemical company, and the writer made several visits to Philadelphia working with our collaborators, Mr. Urquhart and Mr. Blair, in the preparation of apparatus adapted to our requirements. We had previously received the discouraging advice that linen hose, so extensively used by the Forest Service, would not be suitable for foam because its rough wall would break down the bubble structure. But this was overcome by the addition of a chemical material which lubricated the stream as it passed through, and subsequent tests showed no difficulty in this respect.

Much time was given by our collaborators to the development of the back pack rig, and the final form has not been decided upon as yet. The improvised rig used in field tests was composed of two cylindrical chambers, and mixing was accomplished by the two solution method. The pressure created by the gas formed is insufficient in itself to expel the foam with force. A carbon dioxide cartridge was therefore used. Two methods of expulsion by pressure are possible: the cartridge above mentioned and a hand air pump. The pressure type, however, has disadvantages; stronger tank construction is required, weight is added and time is lost in refilling and compressing. This has led to the development of a compact rotary pump unit weighing only three pounds. It is believed that this will eliminate the disadvantages inherent in the pressure types, and furthermore, can be used to expel foams, chemical solutions, or water from the same type of back-tank.

For the first experiments on the Monongahela an area was selected in a level open field, with adequate water supply and near a CCC camp. Later it is planned to conduct the work with running fire in natural standing forest cover, but for the first tests it was thought better to use prepared stacks of fuel. These were arranged so that the comparative effectiveness of water and chemicals could be measured with the greatest accuracy. Duff, logs, and pine and hemlock slash were used in varying composition, density, and size, but always in identical pairs.

A weather instrument set-up was made on the field, and throughout the experiments continuous record was kept of wind velocity and direction, relative humidity, temperature, and sun and shade.

For the pump and hose tests we used a Type Y Pacific Marine Pump, 700 feet of 1½-inch standard linen hose, and a specially designed light weight foam generator, with funnel hopper which in all instances must be set in the line not more than 100 feet back of the nozzle.

For the back-pack tests a "Ranger Special" bag and hand pump was used for water, and this improvised rig previously described (with 3/32 inch nozzle) was used for foam application.

Ignition was in all instances accomplished with Propane Torch, uniformly. Comparative fuel stacks were allowed to burn the same length of time and until maximum flame mass was created.

The planning of experiments, the ground layout, the personnel organization, and the recording were handled in a thoroughly efficient and fair manner by the officers of the Monongahela Forest, assisted by the local CCC overhead.

Test No. 1. Water vs. foam for knockdown of flames on smaller size fuel stacks (10′ x 4′ x 2½′). Pump and hose. Nozzle 25 feet from fire. Water extinguished flames in 70 seconds. Foam extinguished flames in 40 seconds. During foam application humidity was 10 points lower and wind 2 miles greater. Neither stack reignited.

Test No. 2. Water vs. foam in pre-treatment of "wetting down" of fuel ahead of fire. Larger size stacks (15′ x 8′ x 2½′). Pump and hose. Object: To determine comparative checking effects of liquids and the time wet-down area would resist encroachments of fire. Lee half of each stack wet down for 1½ minutes. Action here was watched and various effects recorded for about 1½ hours, but briefly the result was as follows: The wet half of the foam treated stack resisted advance of fire for 30 minutes and was never completely consumed. The wet half of the water treated stack lost its resistance in 2 minutes and shortly after was completely consumed.

Test No. 3. Water vs. foam for corralling a fire with back-pack rig. Windrows of slash 100′ x 3′, varying in width from 1½′ to 2′. Man with "Ranger Special," containing 5½ gallons water, started at one end working along line of fire, using fullest energy, was able to apply water for 6 minutes and 10 seconds, and suppress 40′ of fire line. Same man with foam rig containing 4½ gallons foam solution, working along line in same direction, was able to apply foam for 2 minutes and 10 seconds, and suppress 100′ of fire line.

This method, which simulated the effort of a man (or crew) to knock down the head of a hot fire by direct attack, demonstrated that under these conditions the foam treatment knocked down and held 48′ of fire in one minute, while the water treatment knocked down and held 6′ of fire in one minute.

Test No. 4. Water vs. foam for fire knock down. Pump and hose. Larger stacks. Hose nozzle 25′ from fire. Water knocked down flames in 15 seconds and applied for 2 minutes more. Foam also knocked down flames in 15 seconds and applied for 2 minutes more. Water treated pile reignited in 2 minutes, was completely afire in 40 minutes more, and was consumed in 38 minutes more. Foam treated pile reignited in 4 minutes, burned only with small flames in spots, and after 148 minutes (the last record taken) the entire stack had not ignited and was smoldering.

Test No. 5. Water vs. foam for mop-up with back pack rig and hand tool. Smaller stacks. Man with "Ranger Special," containing 7 gallons water, followed by man with Council Tool, knocked down flames with water in 35 seconds, pulled fuel apart with Council Tool and applied water to smoldering material for 97 seconds more. Fuel reignited in 13 minutes. Man with foam rig containing 4½ gallons foam solution followed by man with Council Tool, knocked down flames with foam in 25 seconds, pulled fuel apart with Council Tool and applied foam to smoldering material for 105 seconds more. Some smoldering and small smoke after 3 hours but no flames. These stacks proved too small for adequate comparison in the two methods. Little indicated except efficacy of foam in preventing reignition.

Test No. 6. Water vs. foam for mop-up with pump and hose, back pack pumps and hand tools. Larger stacks. Water from hose applied for 2 minutes to knock down flames. Followed by 4 men with water-filled "Ranger Specials," 2 men with Council Tools, and 2 men with shovels, who pulled fuel apart and mopped up for 4 minutes, 5 seconds to get the last smoke. On comparable stack, foam from hose applied for 2 minutes to knock down flames. Followed by 2 men with Council Tools and 2 men with shovels (no back-pack rigs), who pulled fuel apart and, although only small smokes visible, mopped up for 3 minutes, 5 seconds. Shovel mop-up by scooping up ground foam and applying to smoldering material. More foam than necessary had been applied by hose men.

Since the completion of these first experiments others have been conducted and others planned. Profiting by experience, tests within the next six months should produce definite conclusions which can be supported by rules of application and by specifications of chemicals and apparatus. It is

early for conclusions but certain effects were so obvious that they may be set down:

1. A gallon of water mixed with a pound of foam compound is more fire suppressive than a gallon of water.
2. Foam compounds can be "loaded" with flame-resisting chemicals to make them more effective. This phase of the work deserves much more attention.
3. Back pack foam rig shows great effectiveness in knock-down and mop-up work. Every effort should be made to perfect it mechanically without too much weight.
4. With back pack rigs these tests showed a ratio of 8 to 1 in effective footage of line, as between foam and water treatment.
5. Back pack foam rig eliminates the considerable fatigue of hand pumping and gives the operator a psychological boost, induced by confidence that he has a new power back of him.
6. Whatever performance is secured through use of pump and hose line is equally possible with tank trucks.
7. Pre-treatment of fuel ahead of fire to check the advance and pemit line building may create a new technique. Foam permeates, clings, and remains, while water vaporizes.
8. Foam will probably be more effective than water as an aid in back firing.
9. If foam is used at the head of a crew as knock-down agent the men will be given a break to get in and hold the partially suppressed fire.
10. Foam, sparingly applied, is an effective mop-up substance. Any surplus on the ground can be applied with a shovel.
11. Reignition after application is much slower when foam is used than when water is used.
12. Only when foam is used in comparison with water in differing, natural fuels on going fires will all of its faults and merits be determined.
13. Packing heavy chemicals up to the head of a hose line or to back-pack refilling points in rough country is a disadvantage to be considered.
14. Foam can only be an auxiliary, and its relative use-position to established tools and methods will determine its final importance.

CHEMICALS IN FIRE CONTROL

From the Forest Products Laboratory, Madison, Wis.

The Service has this year initiated active work in an effort to learn whether chemicals have a place in forest fire control and suppression. Work on chemical phases will be centered at the Forest Products Laboratory, where studies on fireproofing of wood have been carried out and where a trained staff of chemists is available. Field tests will be made in cooperation with the various experiment stations and the Division of Fire Control.

Work has been started along the following lines:

(1) A survey of the literature on the subject, particularly on the application of chemicals to fire fighting; (2) a preliminary survey of chemicals for the purpose of picking the most promising ones and determining concentration for field trials; and (3) participation in field trials being made under the supervision of the Division of Fire Control of foams that are in use in other fields of fire suppression. At the earliest possible moment the Laboratory will undertake field tests in cooperation with the experiment stations.

The review of literature is revealing a dearth of scientific information on the subject and the need for research as a basis for the work. A preliminary comparison of chemical solutions with water has been started using a method devised by a Denmark investigator, F. Folke, in which a given quantity of wood of similar size and arrangement is ignited and allowed to burn until a definite amount of material is consumed. The quantity of water and chemical solution used and the time required for extinguishing give numerical comparative values. From the laboratory tests chemicals will be selected for field trials.

The project involves many problems aside from the actual choice of chemicals, such as the most effective method of applying them; adaptation to different fuels, forest conditions, and field equipment; effect of chemicals on equipment, etc. These will be investigated as the work progresses.

FIRE BEHAVIOR STUDIES ON THE SHASTA EXPERIMENTAL FOREST

JOHN R. CURRY

California Forest and Range Experiment Station

Studies of rate of spread and fire behavior take many different forms —which is as it should be. It is a large subject and fire executives will not be able to manage suppression jobs with assurance until the complex forces which make fires run swiftly or slowly are better understood. Here is a brief statement on the methods being used in California in the study of the subject.

How big will a fire be under given conditions of time, fuel, moisture, wind, and slope?

Is there a natural law governing the combustion of fuels in the open; can it be defined?

What are the physical characteristics of forest fuels that control their tendencies to carry fire under given conditions of wind and moisture?

Do small fires spread more rapidly with increase in time, provided other conditions remain constant?

The solution of questions such as these is the final purpose of the major program of forest research being conducted on the Shasta Experimental Forest, an area dedicated to the study of problems in forest fire control in northern California.

Questions of the relative importance of such studies may be raised. Would it not be more productive to study directly methods of fire suppression, fire prevention, or hazard rating? Will not studies in these latter fields be more productive of concrete results than studies of the more general subject of fire behavior? These questions were carefully considered before these present studies were begun. Under many conditions, indeed, it may be preferable to concentrate upon studies of more direct application. It does appear, however, that without a better understanding of the principles controlling the behavior of fires, we are seriously handicapped in our attack upon the problems of more direct practical application. If the laws governing the rate of spread of fires were clearly understood, we could approach the whole fire problem with greater confidence and with increased opportunities for success. While California has many baffling problems in all fields of fire control effort, there is a unanimity of agreement among both administrative and research men that research should in general concentrate on fundamental aspects of the fire problem. If these principles can be clearly defined, there is a conviction among all that fire control practice will be greatly benefited It is felt that knowledge of the

behavior of small fires is not only desirable but unquestionably essential to the proper distribution of fire control effort on the National Forests of California.

The approach to this study has consisted in starting over 300 small fires in the most uniform conditions available, second-growth ponderosa pine stands, principally on level ground. Fires have been studied under all conditions of wind and moisture experienced during these seasons. They have been allowed to spread for periods varying from 10 to 30 minutes or longer, with an average period of 22 minutes. On each fire a record of wind and moisture conditions is kept, together with a record of the perimeter of the fire at each two-minute interval. In addition, a quantity of descriptive information is obtained.

In analyzing the data, three basic factors—wind, moisture content, and time—have been found to have an important bearing on the dependent variable rate of perimeter increase. Because of the lack of any method of quantitatively evaluating the effect of variations in fuel conditions, the plots used have been carefully selected for uniformity under the assumption that by this method the fuel factor could be disregarded. On a portion of the fires studied on slopes, the slope factor was, of course, taken into consideration. The results of the analysis are not as clear cut and as convincing as desirable, but indicate plainly the importance of the factors considered in influencing perimeter increase. A summary of the work accomplished to date will be published as soon as possible.

The analysis has shown that further refinements in the techniques of measurement is necessary, if we are to fully evaluate the effect of all factors. Consequently, present research is being concentrated on individual studies of the wind, moisture, and fuel conditions to obtain methods of precisely measuring these factors.

The plans for future work involve, first, the development of satisfactory techniques of factor measurement and, second, the extension of the study in the pine type as well as to other more complex types. Preparations have already been completed for test fires in the brush type.

Experiments of this character, aimed at the evaluation of basic factors, are characteristically difficult of attack and are productive of results only after long study. On the other hand, if the fundamental relationships existing between the factors which control fire spread can be defined, all phases of fire control effort will be benefited.

NORTH WINDS AND NATIONAL FOREST FIRES IN CALIFORNIA

The following account of October fires which received national publicity has been taken from a report by Regional Forester S. B. Show.

Constant touch with the Weather Bureau confirmed our belief that Region 5 was entering one of the most dangerous fire periods in its history and that we would be very fortunate if we could emerge from this situation without a blackened record.

Local Weather Bureau officials have worked up the following summary of the weather conditions that brought about the acute fire situation beginning October 14, and continuing to the morning of October 17:

"The fire-weather situation which began on October 14, 1936, was one of the severest and at the same time most clearly typical that has come under the observation of the district forecast office at San Francisco. It began with an invasion of the far western portion of the continent by a transitional Polar-Pacific air mass, which was associated with the rapid development over the Western States and adjacent ocean of a huge anti-cyclonic system, successively centered as follows:
"October 14 about 600 miles west of San Francisco.
"October 15 about 200 miles west of Columbia River Entrance.
"October 16 over southern British Columbia.
"October 17 over Wyoming.

"Neither the anti-cyclone nor the air mass of which it was composed would in themselves have evolved the acute fire situation attributable to them in this instance, had it not been for the cyclonic circulation which developed on the south side of the high pressure field, viz., over Southern California. This development took place on the 15th and reached its apogee on the 16th, when the pressure gradient may be inferred from the following: Highest pressure on Pacific Slope 30.52 inches at Kamloops, B. C., and lowest 29.64 at Yuma, Arizona. This gradient was clearly implied by the winds, which on both dates were NE fresh to strong over Northern California, and locally of gale force where topography required. As is always the case with northeast winds at this time of year, the relative humidity was extremely low, a fact which, in view of the unusual wind velocities, explains the extraordinary contemporary fire situation in Northern California, particularly over the northern Sierra and the northern Coast Range, which were directly athwart the path of the strongest winds.

"Both the advent and the termination of the general hazard were easily predictable by means of synoptic meteorological data. The coming of the anti-cyclone with its north to northeast winds was very evident as will be seen by inspection of the fire-weather forecasts for California on the 14th and 15th. The termination of hazard was governed by the cyclone which, developing over Southern California, caused general rains in that area from the 16th to 19th, and whicch, by traveling northwestward, introduced a marine air mass of high vapor content to the northern portion of the State. This air mass movement was evident by noon of the 16th, when assurance was given that by Sunday (the 18th) the fires in the central Sierra would be easily controlled if not altogether extinguished."

In addition to the information submitted by the Weather Bureau, we wish to add that accurate wind instruments registered wind velocities as high as 70 miles per hour on the Sierra and up to 80 miles per hour on the Tahoe Forest.

This extremely high wind, coupled with the fact that lesser velocities from 40 to 60 miles per hour were maintained for over twelve hours be-

ginning the evening of October 15, resulted in broken communication lines and left forests without communication to their lookouts, guard stations, and suppression crews, and on the Sierra Forest communication by telephone between Northfork and Fresno was out for over ten hours. This break in one of the most essential tools of fire protection was partially corrected by radio during the early period of the high winds with a complete communication setup by means of radio as soon as the organization could be effected, which was within an hour or two.

Roads closed by as many as 50 fallen or broken trees per mile added to the difficulty of reaching the fires with man power.

The following fires started during the early stages of this period:

Forest	*Location*	*Cause*	*Area*
Sierra	Bretz Mill	Burner	1,200 A.—Private
"	Whiskers	Camp Fire	900 — "
"	El Portal	Power Line	900 —Govt.
"	Goodman Ranch	" "	4,000 —½ Govt.
"	Mitchell Ranch	" " Burned	
"	Church Ranch	" " together	8,000 —⅓ Govt.
Tahoe	McKenzie Mill	Burner	23,000 —½ Govt.
"	Plumbago Mine	Unknown	3,000 —Unknown
"	Remington Hill	"	Negligible
Stanislaus	El Portal	Sierra fire jumped river and burned	400 —Govt.
"	Tuolumne Lumber Co.	Unknown	No area inside
Eldorado	3 Fires	Power Line	Negligible

No severe damage to Government timber resulted from the Sierra fires.

The most disastrous fire was the one started from the McKenzie Mill near Westville. This fire traveled almost due west from Westville to Iowa Hill, and during a 12-hour period burned a total area of 23,000 acres, which practically cleaned out the timber on the ridge from Westville to Iowa Hill, a distance of over 12 miles. Approximately 25 million feet of Government pine timber were killed outright by this blaze, with lesser losses to Government timber scattered in smaller patches throughout the interior boundaries of the burn. It is estimated that approximately 100 to 150 million feet of timber were killed by this fire, about two-thirds of which were private.

Timber Management has already looked over this area with a view to salvage operations.

The Tuolumne Lumber Company blaze, near the Stanislaus, destroyed the entire lumber yard (approximately 6 to 10 million feet of lumber). The mill, however, was saved.

On the Sierra, 1,100 men with the necessary complement of overhead

and equipment corralled all six fires by the evening of October 16, less than 24 hours after start. The Stanislaus and Eldorado suppressed their fires during the first work period.

The Tahoe forces, approximately 900 strong, could not handle their large 23,000-acre fire until the wind had died down. This fire did not quit crowning for over 12 hours. They did, however, place a corral line around it as soon as the weather conditions made it possible to hold what lines they were able to build.

The efficiency of the Army in establishing rationing facilities and the cooperation by outside agencies were high lights of the campaign. Though the record looks bad, yet we feel that we came out of one of the most serious and trying situations that Region 5 has experienced in years, with losses much less than we would have had if we had been unprepared and had not been waiting for just such a situation.

> More emphasis can well be placed on training temporary men to submit accurate reports. We believe that when the reason for reports is driven home, *i. e.*, that the study of the reports is fundamental in determining ways and means of getting better fire action and saving of time, then the men have been the necessity for reports and a long step has been taken toward getting more accurate ones.—District Ranger M. B. Mendenhall, Cabinet.

WHAT HAPPENS WHEN THE DREADED EAST WIND FINDS CLEARING FIRES BURNING IN OREGON

The following account of the fall fires in Oregon and the part played by the Forest Service is taken from a report by Regional Forester C. J. Buck.

On September 26 a strong east wind, coupled with low humidity, caused a large number of disastrous fires. The worst situation was outside the National Forest in Coos and Curry Counties in Oregon, where the extremely bad fire day found many unextinguished fires on ranches and in slashings. The east wind spread these fires over considerable areas, burning the town of Bandon, with 11 lives lost and property damage of about $2,000,000. In addition, some 50 families living on ranches throughout the area were burned out, and there was a considerable loss of livestock.

Final figures are not yet available on the acreage burned, but a rough estimate of the area in Coos and Curry Counties is between 90,000 and 100,000 acres. According to reports, very little mature timber was damaged, but reproduction up to 20 inches in diameter was destroyed, including a considerable amount of Port Orford cedar.

Upon an examination on the ground, I found that there were a large number of uncontrolled fires in Coos County within the State protective area, handled in cooperation with the Coos County Fire Association, and that the situation was fraught with possibilities of further disasters to towns and communities. The State forces were very evidently strained far beyond the limit, and a recurrence of bad east-wind fire weather would threaten everything in Coos County. I therefore made two proposals to the Governor: one, that the Forest Service would immediately undertake a survey of the situation about the larger towns and settlements, make definite plans for the protection of lives and property within those towns, and would devote the services of 500 CCC to this work until the emergency should be over. The other proposal was that the Forest Service would immediately take over fire fighting on some 175,000 acres additional of State protection area lying immediately outside and approximately six miles distant from the north boundary of the Siskiyou Forest. This area had between 20,000 and 30,000 acres burned over and some 12 or 15 uncontrolled fires. The extent and number of fires was unknown. Visibility conditions were very bad, so that scouting was the only possible method of obtaining the location, size, and number of fires.

The Governor accepted both proposals, and the Forest Service, under proposal one, immediately moved into headquarters at Coquille, Oregon, and with eight experienced fire suppression men began the development of plans about the towns of North Bend, Marshfield, Myrtle Point, Coquille,

Port Orford, etc., began mop-up work on threatening fires near the towns and started the construction of fire lines. This work, which is still going on, is being done in cooperation with the mayors, fire chiefs, and other city officials. The work itself may result in the prevention of a considerable loss of property and lives at the present time in case of recurrence of extremely bad fire weather. Coos County has as yet received but little rain, and the work is still going on. As a result of the progress of this work to date, the Region has determined that similar advanced fire suppression plans and possibly some fire line construction work will have to be planned out for many towns and settlements within the National Forests. An effort will be made to have town authorities carry on such work, and in any case the preparation of advanced plans will show what is to be done in case forest fires threaten the communities.

At the present time, October 6, the fire situation is still bad in Coos and Curry Counties. Forested lands in these counties are closed to entrance by the people, with the result that hunters cannot operate. But little rain has fallen. The fire suppression work on the additional area taken over from the State is proceeding nicely, and it is hoped that within three or four days these fires will all be under control. Some 1,800 men are now at work on the State area in Coos and Curry Counties and about 100 men within the National Forest protective area, where all fires have been under control for several days. Only a thousand or two acres of National Forest land have been lost.

It may be stated here that one of the prime causes for the destruction of Bandon, Oregon, which is almost completely burned—some 300 or 400 houses, homes of 1,500 people—was the tremendous amount of Irish gorse on the streets of the town and in its outskirts. This plant was introduced several decades ago from Ireland and has attained an unusual size and vigor at this point. It is highly inflammable and carries fire long distances.

It is evident that the preparation by the Region of various fire prevention plans about towns and settlements, at least within forest protective areas, will reveal conditions of this character and bring them sharply to the attention of the city officials.

FOREST RADIO PLAYS VITAL FIRE ROLE

From an October News Release Report on Use of Radio in Western Oregon Fires.

The important part played by Forest Service short wave radio in meeting the recent forest fire crisis in southwestern Oregon was related this week by Forest Service Chief of Fire Control J. F. Campbell and Radio Engineer A. G. Simson, who have just returned to Portland from the fire area.

These men state that a radio communication system covering hundreds of miles of fire front and coordinating through the Forest Service fire headquarters at Coquille, Oregon, kept the fire base in continual touch with remote areas where hundreds of men worked and where accidents or sudden "flare-ups" called for immediate attention. Short wave radio, though not a substitute for telephone, supplemented the telephone system in districts far from established communication.

"At the Sandy Creek fire, which was a bad one," said Campbell, "large crews moved into the woods over narrow trails. Pack trains carrying daily supplies were swallowed up so far as the outside world was concerned. Under the old system foot sloggers over miles of trails would have been the only means of delivering messages, and these messages might involve the safety of lives or urgent need of shifting forces. Portable short wave radio stations met the need and kept headquarters in immediate touch with this as with all other fire points."

Some 50 short wave radio stations have been in use in the fire area, according to the Forest officials. One central control station systematized the work of these stations giving quick clearance to urgent messages but calling for the routine business from some 10 strategic fire camp stations in regular rotation at least once every hour. Food, equipment, and other needs were promptly attended to in this way.

When the telephone system went out after the burning of Bandon, Forest Service short wave stations were installed by State police at Bandon and at Coquille, restoring vital communication with the Bandon district.

"This was a country full of fires," said Campbell, commenting further on the situation. "The Sixes River fire alone had a circumference of 68 miles. The Forest Service scout unit had to patrol these fire lines and keep head-

quarters posted on the dangers and progress of the blazes. Immediate action was needed. Without these small portable radio stations that could be set up anywhere in the woods the effort at fire control would have been much less effective. Radio undoubtedly helped save many acres of forest and possibly saved human lives."

Simson and Campbell report that forces are being reduced in the fire area, but that the communication system and fire crews will be needed till rain comes. The most popular portable radio, they said, was the small P F model weighing about 16 pounds and easily carried in a back pack. These Forest Service radios now generally used in forest work are Northwest products, having been developed at the Forest Service Laboratory in Portland, Oregon.

I should like to suggest the idea that on large project fires we would accomplish more by:

1. Doing line construction from 6 p. m. to 10 a. m., with patrol only from 10 a. m. to 6 p. m.
2. Dividing the available man-power into three crews, each working for one successive 8-hour period.

I believe that crews high-balled for 8 hours at night and during the forenoon will produce more held chains per man day than a crew working from daylight to 6 p. m. This would mean three crews working on the line each 24 hours, but considering travel time, each crew would be working at least 10 hours per shift. Personally I should like the opportunity to try the scheme. With the large amount of man-power that was rushed to fires during the past season, three 8-hour shifts would have been available from any fire camp.—District Ranger M. B. Mendenhall.

RINGSIDE SEATS BY RADIO

F. V. Horton

Forest Service, Portland, Oregon

Sometimes we wish that the public could get the feel of what happens on our fire lines. Listeners might become prevention crusaders if they could get the story, hot from the fire line by radio. It can be done. The author describes one such broadcast from the Sims fire in Oregon in 1935 and suggests alternatives.

The Oregonian, KGW and KEX, ran a wire into our station, KBAA, at our Forest Service radio laboratory in Portland; that is, they connected their transmitter with our receiver at KBAA. We broadcast from the fire line over our regular equipment, using an M set; a pick-up was made in our Portland laboratory, and fed into the special wire to KGW, where it was rebroadcast on the station's regular frequency. This arrangement could only be made where the commercial stations were willing to go to the trouble and expense of such a hookup, and even then, the rebroadcast system is not too good in the summer. The two transmitters amplify the noise, and fading is experienced, etc.

A far better arrangement would be to inform the public of the frequency of our Forest Service transmitters, and endeavor to have them pick up the broadcasts directly. Of course we would lose considerable, both in coverage and in publicity, by using this latter method.

It was necessary to have one of our radio engineers at our Portland station handle the rebroadcast; that is, to monitor and see that everything was functioning properly. I would hesitate to attempt such a broadcast unless I had competent men such as our own radio personnel to handle it.

A word about the actual broadcast itself might not be amiss. In the first place, I believe it would be inadvisable to attempt to broadcast from all fires. I believe that a broadcast would only be justified where either the fire was of extraordinary proportions, or was of immediate importance to a large number of people. The Sims fire was a particularly good one on which to base a broadcast. Perhaps it will serve as an example.

The Sims fire was incendiary; it was on the watershed of the university town of Eugene, which, by the way, owns its own power plant. The nearby McKenzie River has been publicized for years from the standpoint of fishing and recreation. That made the setup one which would demand immediate attention from a rather large audience, since everyone in Eugene or who might have been interested in the McKenzie would feel that they were suffering a personal loss.

The broadcasts from the fire line itself are extremely difficult: first, because they have to be somewhat extemporaneous; even at the best only a rough outline of the broadcast can be prepared in advance. It is essential that the man broadcasting have a good command of words, a good sense of the dramatic, and considerable imagination. He must find for each broadcast at least one human interest episode, and this of course means that he must recognize these when he finds them, or be able to elaborate on some small episode which actually has happened. On the Sims fire, when one of the fire fighters was killed, the regrettable affair was dramatized by stating that his mother would probably receive the news of his death by way of the broadcast. This was literally true, since there was no opportunity to communicate with her before the broadcast went on the air.

I believe it would be disastrous to attempt broadcasts through local radio stations unless the fires were real spot news. There is a possibility, however, of publicity through informing the public that by listening on a certain frequency at a certain time, they may be able to pick up the Forest Service sets operating on the fire line, and then use a few minutes of the day to relate events and give a description of what is happening on the fire front.

Designers and developers of fire plows tend to think in terms of great weight and power because, perhaps, of failure to begin by asking four questions, the answers to which should serve as the starting point for invention.

1. What is a fire line for?
2. How wide must a fire line be?
3. How deep must it be?
4. How important is the weight of the tool and the tractor required to pull it?—Roy Headley.

SPEEDING UP FIRE-LINE CONSTRUCTION BY THE ONE LICK METHOD

KENNETH P. MCREYNOLDS

Rogue River National Forest, Region Six

Everybody deplores the slow speed at which fire line is usually constructed and recognizes that many fires get away because of inefficiency in converting available energy into held line. Too often the proportion of men on the line who are actually working or even moving is absurdly low. The fault lies not with the laborers, however, but with the men responsible for organization and planning. The following paper delivered at the Spokane Fire Control Meeting in February, 1936, tells what was done about it in one place during the 1935 season. Developments of the season of 1936 will be reported later.

In his letter of May 25, 1935, the chief summed up the situation in regard to the speed of fire trench construction as follows: "I am unable to regard our customary standards of held-line production as due to anything but our own deficiencies as students, organizers and executives. We have made some headway in the development of machine tools which are of great importance in the speeding up of held-line construction and for increasing the output of held line per man-hour. But when it comes to the techniques of organizing and managing men for a high-speed hand tool job of line construction, I must admit that my feeling is that we are much nearer to where we were in 1910 than to where we ought to be today."

In the same letter the following suggestion was made: "If in our thinking we could break clean away from our accustomed habits and take a fresh start, what would we set up as the inescapable limitation upon the speed with which a line can be constructed from a fixed point on around a fire through a stand of heavy chaparral, for example? Aside from the question of safety in working men, is there any inescapable limitation upon our speed under such circumstances except the limitation upon the speed which one man can make when floundering through a heavy stand of brush, making a slash with his brush knife each step or so? Could we not, if we mobilized sufficient properly organized and directed men behind him, widen and complete the clearing, do whatever trenching is necessary and even under some circumstances complete the backfiring at rates per hour which would not fall too far below the speed per hour made by this head man? Incidentally, this head man should, of course, be changed (with the rest of the crew) from time to time if the task was to make the maximum attainable speed from some single point at which a line could be started."

During the course of training in the CCC camps on the Rogue River National Forest, the system as outlined in the chief's letter was first given a trial on a mock fire.

The selected site of the proposed line construction was up a 25-50 per cent slope of a ridge covered with dense manzanita and scattering ponderosa pine.

It was difficult under those conditions to determine the number of men necessary to construct a completed trench and keep up with the lead man. Consequently, there were entirely too many men used on this first trial.

The crew consisted of 192 enrolled men and leaders, four foremen, and two other facilitating personnel. The men were organized, trained in the use of tools, and the system was discussed with them. Otherwise, so far as fire suppression was concerned, they were a green crew.

The distribution of men and equipment was as follows:

1. Leader.
2. Forty-eight axmen, two sets of fallers.
3. Fifty-six men with hoes, 16 with Kortigs.
4. Fifty-six men with shovels, four sets of fallers, four extra axmen.

The hoes and Kortigs were worked in the same manner as the axes, each man as he continually moved forward or paused only a moment added some work on the actual trench. None of the axmen or the men with hoes were permitted to pass each other.

The lead man located 3,300 feet of trench in 45 minutes, and when he finished, the trench was practically completed behind him or was within a few minutes afterward. The speed of completed line was approximately 31 links per man-hour. While this does not include backfiring and patrolling, two important factors were brought to light. First, at least 25 per cent of the men were unnecessary and did not have an opportunity to work at all. Second, the trench was completed in approximately the same time as it would have taken to move the men in, using the sector method, and to distribute them on the fire line.

The following day at another CCC camp, with practically the same type of personnel, the system was tried again. This time the crew consisted of 154 enrolled men and leaders, four foremen, and two facilitating personnel. This demonstration fire line was located in a light Douglas fir type with moderate amount of underbrush.

The tools were in proportion to those used on the previous day. In this case the results were 40 chains of trench completed in 25 minutes, or at the rate of 60 links per man-hour. However, this did not include backfiring and patrolling. But again, at least 25 per cent of the men were not needed.

The third trial was on an actual fire. In this case the ground cover was practically pure brush, mainly very dense manzanita, on a 45 per cent slope. The crew used on this fire was trained in this type of organization,

split, 25 working on a side. One crew used this "one-lick" system, and the other the sector system. The one which used the sector system completed 24 links per man-hour, while the other made 72 links per man-hour.

The system was used in a more or less modified form on small fires during the season, but in the latter part of August on the Rainbow Creek fire this system of organization produced some real results. The events which led up to this case were as follows:

First: The men had not been trained in the use of the system, except that it had been discussed with the foreman.

Second: The entire crew had been working all day the day before. They were on the fire from 10:00 p. m. to 8:25 a. m. the night previous. They were off the fire line only nine hours during the day previous to the actual demonstration and consequently were not in the best of condition.

Third: The ground was very rocky. The cover was thick snowbrush, both dead and alive, and true fir reproduction which varied from scattered trees to thickets. The topography was rolling, 5 to 30 per cent slope.

The crew, consisting of 60 enrolled men and leaders and two foremen went on the fire at 5:11 p. m. At 7:30 p. m. they had constructed, backfired, and were patrolling two miles of fire line. The crew then was able to patrol and hold this sector and, in addition, with the aid of a brush-plow unit mounted on a "35" Cletrac, also completed, backfired, and held an additional mile of line until 3:00 a. m. the following morning.

The speed of held-line construction for the first two miles was 118 links per man-hour, or 37 links per man-hour for the entire shift, which was a far longer period than the men should have worked.

Those tests have brought out several points:

First: The number of each type of tools for a crew of a given size will be the same as though the crews were working in sectors. The type of tools will, of course, also vary with locality, cover, etc. In general, the axes are ahead, followed by the hoes, then snag-fallers, shovels, and torches. Backpack cans, a few shovels, and several sets of fallers should, of course, be used with the advanced portions of the crew to cool down hot spots and get the bad snags, etc. Also, some axes should be held back with the shovels to assist in strengthening the trench and to catch spot fires. The main part of the saws to buck out logs and fall remaining snags will be with the patrol crew in the rear.

Second: The crew should not be allowed to string out. They should be kept as close together as tools can be used safely. This will keep the fire from breaking through the crew. So far as it has been able to determine at the present time, there is no more danger of the fire breaking through the crew, or perhaps not as much, than when the crews are working in sectors.

Third: It does not seem advisable to give strawbosses or section leaders tools. They have all they can do to see that the men are properly distributed, to keep them moving and working at the same time, and to look out for the safety of the men. The latter is particularly important with the system, because the men get no opportunity to watch for rolling rocks, logs, and falling snags. If the strawboss is per-

mitted to have tools, he is inclined to slight this responsibility. He should be given a canteen of water and otherwise left free to direct the work of his crew.

Fourth: Water bucks with large containers should be started near the front of the crew where at intervals they can step aside and fill the squad canteens as the crew passes by them.

Fifth: Sufficient men should be added to permit dropping of patrol and backfiring crews, or to make up a separate crew to take over immediately behind the trench crew.

Sixth: The system so far as can be determined can be used with crews from small squads up to 100 men, depending upon cover, etc.

The disadvantages of the system as brought out to date are:

First: Crews must be trained more thoroughly than for other systems. They must know individually what a completed trench looks like.

Second: It is difficult to keep the men moving and working at the same time. There is a tendency for the men to stop and work, then when moved to go too far before stopping, or slowing up to work.

Third: The system is a man-killer. There is no opportunity for them to rest. If one man stops, he is holding up the rest of the crew behind him. It is believed that four hours or less will constitute a work shift on this type of organization. If there are not sufficient men available to control the fire at this rate of speed within this period, the speed should be slowed up, so that the men will be able to continue through the desired period of time.

The merits as brought out by the tests made thus far are:

First: A decided increase in speed of line construction per man-hour. While it is not expected that this rate of speed can or will be maintained on the average, it is believed that a decided increase in the amount of held line per man-hour can be expected in cover types that are similar to those where the tests were conducted.

Second: That the same amount of work is accomplished early in the control period rather than being prolonged over an eight- to twelve-hour shift; naturally, this reduces the ultimate amount of work necessary.

Third: There is a decided decrease in the amount of time used in shifting men. There is always a tendency for the men to slow up when passing other crews.

Fourth: The elimination of the main part of the crews passing each other while working makes for less accidents caused by tools.

Fifth: That except for the first few men, they are not fighting the brush This enables the men to put the maximum energy on actual trench construction.

Sixth: The crews in dense brush can start from a fixed point on the fire and complete a trench to another fixed point as quickly as they can be taken in and placed on the fire by sectors.

There is a considerable amount of experimental work to be done on the system, but so far as the dense brush type or the open timber type is concerned, where there are a few snags and logs to contend with, it is believed that the system certainly merits consideration.

There has been no opportunity to make tests in either the typical Douglas fir type or in old burns covered with a large number of snags.

In some ways the organization is not new. It has in a modified form been used for years. However, the addition of two factors, that is, keeping the entire crew moving forward practically 100 per cent of the time, and the almost entire elimination of men passing each other, has surprisingly increased the speed of hand-tool trench construction per man-hour.

METHOD FOR MEASURING FIRE LINE

With no physical reason to account for it, everybody has seen line production vary widely from hour to hour. Sometimes, also, reports of line produced on a big job run to totals that are incredible considering the size of the fire. A foreman's legs sometimes insist on short steps when measuring the day's production. Furthermore, men with cruiser training would have to learn pacing all over again in order to measure surface distance instead of horizontal distance; and it is surface distance that is wanted in measuring fire lines. The following article on the subject is quoted from the Northern Region News.

Use of a trail measuring wheel to ascertain the amount of fire line constructed each day on 100- or 200-man sectors, where the measuring job is large, is suggested by Stanford H. Larson, District Forest Ranger on the Bitterroot National Forest. This, he contends, would free the sector boss of the task and permit him to direct his attention more fully to more important phases of fire fighting.

It is true, Mr. Larson points out, that the pacing of constructed line each shift is the job of the fire foreman. Experience, however, has shown, he declares, that usually the sector boss must do this. Few men, he said, are capable of pacing well.

Mr. Larson, stressing the advisability of limiting the use of the measuring wheel to the larger units, has this to say in discussing his suggestion:

"If we get down to cases, what does the sector boss have to gauge his actual speed of held-line production? He uses fuel type, time, and distance (chains of line constructed) as his gauge. This he reduces mentally to chains per crew-hour or man-hour. He wants and needs a close check on this throughout the day while work is in progress and not merely at the foreman conference in the evening after the day's work is done. If his output is lagging, he must know how much and where, and know it at the time so that it can be corrected at once, not the next day. If he is going to have an accurate gauge of output to guide him in intelligent supervision, then he must have an accurate measure of current production.

"I consider it highly important that a sector boss know, for instance, that at 8:00 a. m. he had actually built 100 chains of fire line after working 100 men three hours in a medium-resistance fuel type. This he would not know unless current production had been measured. Would it not be of value to know, for example, that under the same conditions Crew No. 1 had constructed 37 of the 100 chains while Crew No. 3 had produced only 18 chains? The sector boss must know these things, not merely suspect

them, as he had in the past. If we are to speed up line production, we have to know and see that every unit of effort is applied where it should be. The sector boss must have an accurate current measure of accomplishment for the following reasons:

"1. To gauge output of his unit as against what is possible for the fuel type.

"2. To gauge production of individual crews within the unit and so detect weaknesses not apparent from casual observation.

"3. To aid in the development and to substantiate technique in line building that will speed up production at the time, not on the next fire.

"4. To insure the use of proper methods.

"Then there is the matter of wholesome competition between crews. The introduction of the measuring wheel would eliminate human errors in measurement and would put all record of accomplishment on the same basis. The mere sight of the device would have a wholesome effect on every man along the fire line. . . .

"The fire boss would also have a reliable picture of daily accomplishment by sectors. Like the sector boss, he would have accurate data on which to base his job analysis and plan of action instead of often erroneous estimates garnered at the expense of many hours of overhead time that would better be spent on supervision of line production.

"Increasing the accuracy of the daily held-line estimate report would be only a fraction of the benefit accruing from the use of this instrument. It is the accurate, undistorted measure of current production used in practical job analysis, at the time, for the express purpose of bettering the next hour's output that counts big. If this basic data can be obtained easily and at the same time give the overhead more time for intelligent planning and supervision, it can't help but speed line production."

ROAD SPEED COMPASS

A. A. Brown

California Forest and Range Experiment Station

In making a transportation plan one of the time-consuming items is the showing of "coverage" on a map. By coverage is meant the area that can be reached within given time limits by a combination of automobile and foot travel, and is dependent upon the average attainable speeds on roads with autos and cross country by foot travel. To simplify and speed the work of plotting coverage, bow compasses were converted to "road speed compasses" by the addition of an index pointer and an accurate scale so graduated that by setting to the mileage distance from a station the compass radius would equal the map distance that could be walked from the mileage distance point within the given time limit. In most cases an average walking speed was determined for a considerable territory and road speeds of 10-12, 15-18, 20-25, 30-35, and 40-45 miles per hour were scribed on a set of five compasses.

In use, mile points were located on a road map from previously obtained road log data and arcs were drawn around these points with a compass calibrated for the road speed, and set at the miles distant from the station concerned. These arcs were then tangently connected so that the coverage figure contained its maximum area. The resulting tapering figure has as a minor axis at the guard station the cross country distance that could be walked within the time limit, and as a major axis along the road the distance that could be traveled by auto within the same time.

When road speeds change, the compass in use must be replaced by one calibrated for the new road speed. As the distance walked is a fraction of the time not used for automobile transportation, the setting of the new compass to the same radius as the old will reveal directly on the scale the number of miles that can be traversed on the new road within the given time limit, as well as the walking coverage that will be obtained.

This simple device is illustrated in the sketch shown (Fig. 1), and was developed as an aid to the transportation planning project recently completed for Region 5.

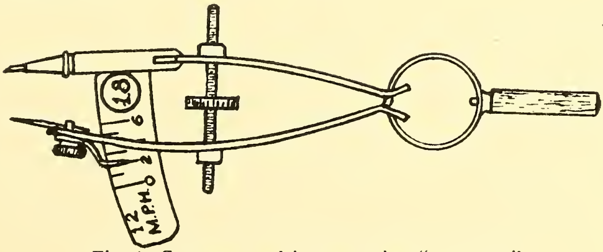

Fig. 1—Compass used in computing "coverage."

FOREST ROADS OR FOREST FIRES

C. J. Buck

Regional Forester, Forest Service Region Six

The following article has been submitted for publication to the Pacific Sportsman.

With such an obvious drive as that of the past few years for emergency relief employment it is small wonder that at least part of the public suspects that many recently constructed roads were not needed but rather were "concocted" to provide work. Nor is the public inclined to discriminate between those projects which it believes were partially "concocted" and projects which for years had been essential parts of carefully worked out plans crying for completion.

Typical of the popular skepticism in certain quarters is a recent editorial in the Pacific Sportsman deploring the fact that recreationists now seek in vain for sylvan territory not traversed by roads. It attributes the "road building craze" in the National Forests to the desire of rangers for the comforts and luxuries of travel. It concedes that some roads are needed in the mountains, but contends that roads have been laid in areas where nobody goes or is ever likely to go, and that there is no need to honeycomb the forests with arteries that are not justified by travel. It raises the question of what will become of the wild life of the forests with the country crossed and crisscrossed with unnecessary roads.

In so far as its statement applies to the Pacific Northwest, the Pacific Sportsman has fallen into pardonable error both as to the facts and their interpretation. Let us deal not with State highways through the National Forests, but only with roads for which the Forest Service is primarily responsible. Some 3,600 miles of these roads have been built in the National Forests of Oregon and Washington since the advent of the CCC. If any road system ever was worked out according to a definite scientific and economic plan this is true of the system of which these CCC forest roads are a part. The central aim was not the comfort of rangers or others but the protection from fire at the lowest cost, of the 26 million acres within the National Forest boundaries of the two States.

The plan for the system originated in 1928 to avoid just such haphazard road building as uninformed critics now suspect. The actual procedure for the National Forests was laid out in 1930-1931, based primarily on the control of fire within time limits which would mean the prevention of large forest conflagration and the holding of burned acreage to a minimum. Careful and comprehensive study of past fire records was made. From this

it was possible to set up periods within which fire in any given type of timber or country must be reached if it is to be controlled without serious loss. This means that every area in the National Forest has its limit set for the allowable time from the "spotting" of a fire to the arrival on the ground of suppression forces. The lookout system, the telephone system, and the road system between them carry the burden of the requirements shown by the survey. The greater the reduction in detection time effected by a better lookout system, the less the burden on the road system which must help deliver fire fighters on the ground within the set period.

Fire suppression involves the first line of defense, consisting of one or two fire chasers for immediate action, and the second line of defense made up of varying sized crews drawn from outside and depending on larger trucks to speed them to the vicinity of the blaze. There is no romance about this grim business. The first hour or two after discovery of a fire usually determines whether the flames will be confined to a negligible area or break out into a real forest annihilating blaze. It is the old war formula or the city fire department formula over again, of "getting there first." Horses and trails are more picturesque, no doubt, but horses had to give way to motors, and of course motors meant roads.

So it was that before the CCC came into existence the Forest Service in Oregon and Washington had mapped its necessary truck roads, 20,825 miles of them, of which only 75 per cent are as yet completed. Waiting with the certain knowledge that large areas for which it was responsible had insufficient fire protection till these roads could be built, the Service welcomed the advent of the CCC with open arms. Upon the Tree Troopers devolved the job of building roads, which incurred some criticism but which added immeasurably to the protection of the forests. The roads they built were not boulevards for convenience. They were the vital arteries which, along with the equally vital telephone nerves from lookout stations, must be counted on to save the forests in the hour of need.

Nor was the present protection plan limited to the lookout, the telephone, and the road system. It called for 35,284 miles of trails, of which nearly 85 per cent are already built. These trails extend like blood vessels from the road arteries extending up from important stream courses or following strategic ridges. Even these trails cannot attempt to cover the ground or lead fire fighters to the exact location of a fire. It does not take great imagination to understand how easily both roads and trails are lost in these North Pacific forests, embracing, as they do, the most rugged and mountainous country, innumerable ridges, yawning canyons, baffling thickets, a grand expanse of unharnessed distance.

It must not be assumed that the Forest Service has not weighed carefully the increased fire hazard to be expected from roads and trails. Unquestionably the hazard is somewhat increased by greater travel in the forest, but it has been found that such travel is better concentrated and better controlled because of trails and campgrounds, while the danger of major conflagrations is immeasurably lessened. Lightning, which is a prolific cause of fires in the mountains, finds its way into the forest, trail or no trail, and the recent road and trail additions have made it possible to combat lightning fires quickly and effectively.

In direct answer to those who still believe that at least some forest roads are built without any excuse other than the convenience of officials and to furnish employment to the CCC, let it be definitely stated that when any new road is proposed the first question asked is: "Is this road on the fire protection plan?" If not on the plan, the proposed road has to run the gauntlet of the most searching scrutiny. Its approval is always weighed on the scales of its importance to fire prevention. As a result few roads are built "outside the plan," and few if any have been based on administrative convenience or 100 per cent for the accommodation of recreationists. The main objective of the Service is the protection of the forests, and until the protection plan is fully realized there is small likelihood of undue interest in other construction.

Now, a word of understanding to the "road haters." Every wilderness lover appreciates that a multiplicity of roads does destroy wilderness charm. It is for this reason that roads have been barred from the 1,446,360 acres set aside as primitive areas in Oregon and Washington. The Forest Service has taken the lead in establishing these wilderness sanctuaries in many parts of the National Forest, at the same time taking into account, however, that the attraction even of these areas is threatened unless fire protection roads are brought within reasonable striking distance of their boundaries. The real need for permanent primitive areas is not being neglected, nor is the protection of game and animal life.

Game and wild life fortunately are not long disturbed by roads. Game animals are coming back in the East in greater numbers than existed in the virgin forest days. Evidently protection and ample forage are more important to them than roadless solitude. Forest fire, on the other hand, is the arch enemy of wild life, as anyone who has followed in the track of a fire will agree. Though Pacific Northwest forests have a comparatively enviable record in fire loss, the figures for the 10 years up to 1933 show that this great destroyer of forests and forest denizens had

devastated in Oregon and Washington an area equal to a small Eastern State. What is the answer of the sportsman to this record? Can the Northwest continue to see its forest land, the home of its wild life, burned over at the rate of 400,000 to 500,000 acres a year?

The proposition finally is this—born from the disheartening history of forest lands in the Northwest and throughout the country: Shall we have protected forests with roads, or unprotected forests without roads? The lesson of the past is so plain that it cannot be missed. It is supported by thousands of cases which have been classified and become the scientific basis for policy and action. The protection of the forest demands speed in putting out fires, and speed in these days of motor vehicles means roads. As the honest tree surgeon said to the patrol whose favorite elm was being destroyed by decay: "This tree surgery will hurt the looks of your tree somewhat, but without it in a few years you will have no tree at all."

We find that a number of our lookouts are borrowing field glasses from neighbors, and buying them from their own funds because they feel that they can increase their efficiency thereby. We strongly urge furnishing reasonably powerful field glasses, believing that such costs will be well paid by quicker detection.—District Ranger F. E. Brown, Cabinet.

AIRPLANE VS. MULE AND TRUCK TRANSPORTATION

H. M. SHANK

Forest Supervisor, Idaho National Forest, Region Four

At the Spokane Fire Meeting in February, 1936, Region 1 of the Forest Service exhibited methods of tight packaging of fire fighting materials to be dropped from the air at fire camps remote from landing fields. Later the specifications for such tight packaging, a very laborious process, were written up and distributed and used in varying degrees on various National Forests. In June, a suggestion (probably first advanced by District Ranger Dan LeVan of the Idaho National Forest) led to initial experiments with the loose package method—a totally different principle In the following article Supervisor Shank reports in detail a part of the further specific tests made in July and gives a summary of a total of 14 tests with his comments and conclusions. Later in the season further tests of the loose package method were made in Region 6. It is hoped that by the season of 1937 complete instructions for loose package dropping from aircraft will be made available for easy use by anyone who may suddenly find himself in the dilemma of needing fast transportation of fire fighting materials and nothing to do it with but an insufficient number of pack animals.

Test No. 1.

Principal Container: Mail sack, tied tightly at top.

Contents:
- 6 lbs. bacon in 25 lb. misprint bag, tied loosely.
- 5 lbs. pancake flour in 25 lb. misprint bag, tied loosely.
- 5 lbs. sugar in 25 lb. bag, tied loosely.
- 5 lbs. beans, dry, in 25 lb. bag, tied loosely.
- 4 pkgs. raisins in 25 lb. bag, tied loosely.
- 5 pkgs. fruit, evap., in 25 lb. bag, tied loosely.
- 7—1 lb. cans brown bread
- 6—4 oz. cans Vienna sausage
- 6—¼s sardines
- 6—8 oz. cans pork and beans
- 1—No. 2 can corn
- 1—No. 2 can string beans
- 3—8 oz. cans jam
- 1 tall can milk

} Thrown loosely in principal container containing six small sacks listed above.

Total Weight: 57 lbs.

Drop. 375 feet to hard packed soil on 30 per cent slope.

Damage:
- 1 can corn, 1 can pork and beans } Bursted, no value.
- 2 cans brown bread, punctured but 100 per cent salvage value.
- Principal container sustained 2 inch rent.
- All other items in perfect condition.

Target Miss: 60 feet.

Test No. 2.

Principal Container: Mail sack tied tightly at top.

Contents: 10 emergency rations (R. 1), weight approx. 5 lbs. each, placed at random in above container.

Total Weight: 53 lbs.

Drop: 275 feet on hard packed, rocky field.

Damage:
- 4—8 oz. cans grapefruit, 3—2 oz. cans coffee } Damaged beyond use.
- 2—1 lb. cans brown bread, 1—8 oz. can hash } Broken but fit for use.
- Principal container sustained 12 inch rent.

Target Miss: 125 feet.

Test No. 3.

Principal Container: 3 mail sacks, tying all three together at top.

Contents:	15 emergency rations, five to each bag as in Test No. 2.
Total Weight:	84 lbs.
Drop:	300 feet to hard packed field.
Damage:	Emergency ration sacks torn slightly. 1—8 oz. can pork and beans 3—8 oz. cans grapefruit } Damaged, no value. 2—2 oz. cans coffee All other items, including principal containers, undamaged
Target Miss:	60 feet.

Test No. 4.

Principal Container: Mail sack lined with 11 lbs. excelsior.

Contents: Improvised mess outfit for 20 men, containing:

2 kettles, aluminum, No. 883.
20 tin plates.
2 pans, fry, large.
4 pans, dishup, large.
20 tin cups.
20 table forks.
20 table knives.
25 dessert spoons.
3 tablespoons.
2 can openers.
1 dish towel
1 soap, laundry.
1 knife, butcher.
1 lifter, pot.

Plates, cups, and dishup pans were nested in the two kettles. Forks, knives, and spoons were tied in separate bundles and a sheath covered the butcher knife. Kettles were placed bottom to bottom and smaller items distributed through the packing material.

Weight:	Mess equipment, 26 lbs. Filler, 11 lbs. Container, 3 lbs. Total 40 lbs.
Drop:	300 feet to hard packed, rocky field.
Damage:	None, except slight bending of kettles, fry pans, and dishup pans—all 100 per cent serviceable.
Target Miss:	60 feet.

Test No. 7.

Four baby shovels thrown loose, without cover or ties, from 200 feet altitude to hard packed soil. Target miss 50 feet. No damage.

Test No. 8.

Three pulaskis thrown as in 7. No covering or ties except hose sheaths on blades. Target miss, 50 feet from shovels. No damage.

Tools in tests 7 and 8 fell slowly with a spiral motion and did not scatter to any extent.

Test No. 10.

Principal Container: Mail sack, tied tightly at top.

Contents:	4 lbs. rice in flour sack, tied loosely. 4 lbs. beans in flour sack, tied loosely. 1 lb. box raisins in 5 lb. cloth sack. 1—5 lb. box dried fruit in 10 lb. cloth sack. 3 lbs. rolled oats in original paper sack placed in 9 lb. sugar sack. 1 can corn 1 can veal loaf 2 cans Vienna sausage } Placed loosely in burlap sack. 2 cans sardines
Total Weight:	28 lbs.
Drop:	300 feet to meadow grass field.
Damage:	None, except slight bending of some cans.
Target Miss:	Not directed at target.

Test No. 11.

The same articles as in Test No. 10 were resacked, plus one emergency ration, and dropped from approximately same height to a well packed gravelly field. Total weight: 33 lbs.

Damage: One can grapefruit and one can hash broken open, the latter being suitable for immediate consumption. Principal container sustained 6 inch rent. Other cans more bent than in first drop, but none admitting air.

Test No. 12.

Emergency ration enclosed in a burlap sack tied loosely, dropped as in Test No. 10, was in perfect condition.

SUMMARY

Test	Class of Supplies	Drop (ft.)	Weight	Target Miss (ft.)	Per Cent of Load Lost	Container	How Prepared
1	Food supplies	375	57	60	4.2	Sack, mail	Tied loosely
2	Emergency rations	275	53	125	2.0	Sack, mail	Tied loosely
3	Emergency rations	300	84	60	5.4	Sack, mail	Tied loosely (3 sacks)
4	20-man mess outfits	300	40	60	None	Sack, mail	With 11 lbs. excelsior
5	1-man S. C. outfits	375	35	200	*	Pack cover	Tied tightly
6	Fire tools	300	21	75	None	Pack cover	Tied tightly
7	Baby shovels	200	....	50	None	None	No wrapping
8	Pulaskis	200	....	50	None	None	No wrapping
9	Fire tools	200	198	200	None	Mail bag	Tight—parachuted
10	Food supplies	300	28	No target	None	Mail bag	Tied loosely
11	Food supplies	300	33	No target	1.5	Mail bag	Tied loosely
12	Emergency rations	300	5	No target	None	Sack	No preparation
13	Emergency rations	300	5	No target	None	Sack	No preparation
14	Emergency rations	300	5	No target	None	Sack	No preparation

*This test might be considered a 100 per cent failure, as fire tools were broken.

After the foregoing, including the summary, had been written, we had a fire on the forest which was supplied almost exclusively by airplane. The equivalent of three days' rations for 50 men and 25 beds was dropped on this fire in timber, and the total loss amounted to two cans of jam, 15 pounds of prunes, and 15 pounds of beans, the latter two items being scattered so badly that salvage was not worth while.

We are entirely convinced that getting supplies to men by airplane is feasible under practically all conditions; that it is not only feasible, but for 50 per cent or more of this forest it is probably cheaper than any other method of supply. The secret of getting supplies to the ground seems to lie entirely in the preparation of loosely prepared containers. Kapok beds can be dropped with negligible damage except for the occasional bundle that might be ripped or torn from landing in trees. They are invariably dropped in bundles of five each, which is about the limit we can push out of the doors of the planes we have available.

USE OF MIL SCALE BINOCULARS IN FIRE DETECTION

John R. Curry

California Forest and Range Experiment Station

The mil scale, as found in military binoculars, may be used for roughly calculating the sizes of objects seen at known distances or the distance at which objects of known size are removed from the observer. The mil is equal to 1/1000 of a radian; in other words, 1 yard at 1000 yards, 2 yards at 2000 yards, etc.

The mil scale in binoculars has been used in the California region to estimate the size of going fires. Although the arithmetical computations involved are simple, to standardize procedure and to eliminate chance of error, the alinement chart shown (Fig. 2) was designed to make the calculations. Dispatchers and lookouts are furnished with these charts.

The readings obtained give only the diameter of the fire in a plane at right angles to the observer's view. To determine the full size of the fire, it will be necessary to obtain measurements from more than one lookout. It is believed, however, that these measurements are much more satisfactory than simple guesses of acreage by lookout observers.

Fire finders can, of course, be used for the same purpose. Their use is governed, however, by the limits to which they can be read accurately. By enlarging the object 6 or more times, binoculars may be used to obtain readings on smaller objects as well as more accurate readings on larger objects.

Inasmuch as the mil scale is not an expensive addition to a standard binocular and interferes in no way with its normal use, it is felt that all binoculars purchased for detection purposes should be so equipped.

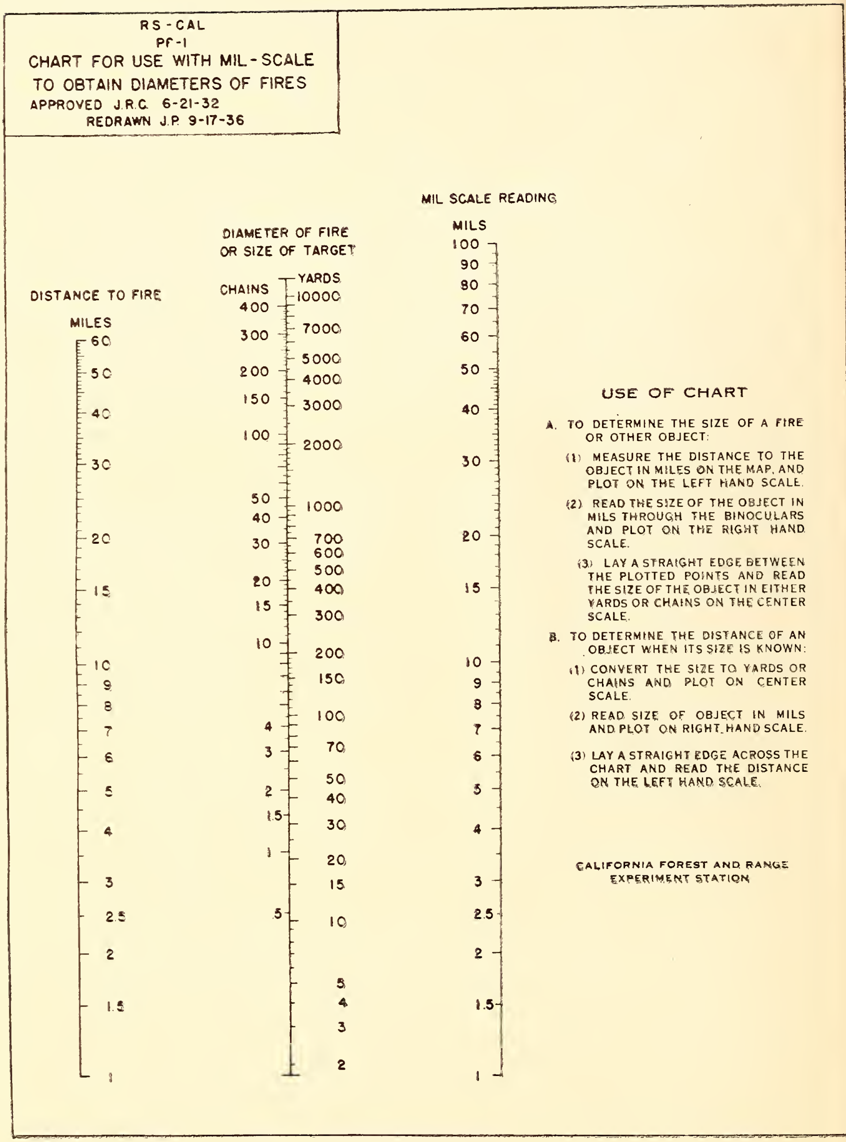
RS-CAL
PF-1
CHART FOR USE WITH MIL-SCALE
TO OBTAIN DIAMETERS OF FIRES
APPROVED J.R.C. 6-21-32
REDRAWN J.P. 9-17-36
DISTANCE TO FIRE
MILES
60 50 40 30 20 15 10 9 8 7 6 5 4 3 2.5 2 1.5 1
DIAMETER OF FIRE
OR SIZE OF TARGET
CHAINS
400 300 200 150 100 50 40 30 20 15 10 4 3 2 1.5 1 .5
YARDS
10000 7000 5000 4000 3000 2000 1000 700 600 500 400 300 200 150 100 70 50 40 30 20 15 10 5 4 3 2
MIL SCALE READING
MILS
100 90 80 70 60 50 40 30 20 15 10 9 8 7 6 5 4 3 2.5 2 1.5 1
USE OF CHART
A. TO DETERMINE THE SIZE OF A FIRE OR OTHER OBJECT:
(1) MEASURE THE DISTANCE TO THE OBJECT IN MILES ON THE MAP, AND PLOT ON THE LEFT HAND SCALE.
(2) READ THE SIZE OF THE OBJECT IN MILS THROUGH THE BINOCULARS AND PLOT ON THE RIGHT HAND SCALE.
(3) LAY A STRAIGHT EDGE BETWEEN THE PLOTTED POINTS AND READ THE SIZE OF THE OBJECT IN EITHER YARDS OR CHAINS ON THE CENTER SCALE.
B. TO DETERMINE THE DISTANCE OF AN OBJECT WHEN ITS SIZE IS KNOWN:
(1) CONVERT THE SIZE TO YARDS OR CHAINS AND PLOT ON CENTER SCALE.
(2) READ SIZE OF OBJECT IN MILS AND PLOT ON RIGHT HAND SCALE.
(3) LAY A STRAIGHT EDGE ACROSS THE CHART AND READ THE DISTANCE ON THE LEFT HAND SCALE.
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

Fig. 2

VERTICAL ANGLE FINDER

A. A. Brown

California Forest and Range Experiment Station

In the use of panoramic pictures, there is a need for obtaining vertical angle measurements. Many of the fire finders used in the California Region are not equipped with vertical angle scales. It is not difficult to work out vertical angle graduations on open sight alidades, but it is difficult and rather expensive to provide for exact leveling of the table or fire finder to permit accurate vertical angle readings. For this reason, instead of putting graduations on the alidade sights, a simple vertical angle reader was developed as a supplementary instrument.

A photograph of an instrument made for use in Region 5 is shown (Fig 3). The vertical angle graduations are drafted on a templet fixed

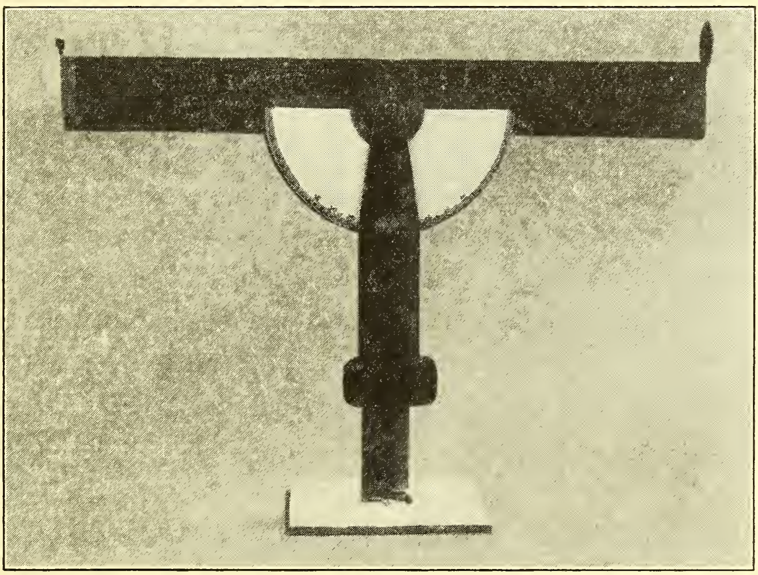

Fig. 3

immovably to the axis of the sight bar and at right angles to the main axis of it. A pendulum, consisting of a brass strip weighted at the end with lead, is pivoted to hang freely over the graduations. An opening is cut to expose a sector of the dial, leaving a pointer in the center. The whole is so constructed that the sight bar is horizontal when the pointer is at zero on the dial. The pendulum arrangement then assures that the zero point will be vertical to a level surface regardless of whether the surface on which the instrument rests is level or not. The sighting device is a peep sight with a horizontal edge at the end removed from the eye. The instrument as built

could be considerably improved, but the principle is a useful one if a cheap instrument that can be furnished in considerable quantity is needed.

This simple instrument was designed by Nelson Salmon, ECF Technician employed on detection planning work, and a number were made up for Region 5 under his supervision.

Detailed specifications can be furnished if desired.

EQUIPMENT IN REGION 6

In its report for the summer quarter, Region 6 (Portland) lists the following items on which some work has been done during the season.

1. A Killefer fire plow directly connected to the tractor and without a wheel carrier. Olympic.

2. A better Killefer plow of the wheeled type. Deschutes.

3. A high pressure spray pump, designed to operate with a small quantity of water, has been developed on the Wenatchee Forest for use on grass fires. This has not yet been thoroughly tested, but apparently is satisfactory.

4. A double disk fire plow intended for attachment to tractors has been designed and is now being constructed.

5. During the past year there has been developed, with the assistance of the Division of Engineering, a horse trailer designed for attachment to ranger pick-ups, which it is felt will be of practical value to rangers in handling fire and administrative activities.

6. Experiments have been made with the Wolf saw which indicate that such a saw with a 36-inch blade can be used satisfactorily to fell Douglas fir snags up to 72 inches in diameter.

RECEDING STRING REELS FOR DISPATCHER MAPS

A. A. Brown

California Forest and Range Experiment Station

These instruments, which are an adaptation of Dietzgen tape reels, are made by that company and are available to Forest Service offices on order through the Supply Depot, Government Island. They are small, enclosed spools mounted on a shaft fastened to a coil spring (Fig. 4). They are wound with silk fishing line, which is threaded through a tube of 1 or 1½ inch length. As received, a bead on the end of the line prevents the

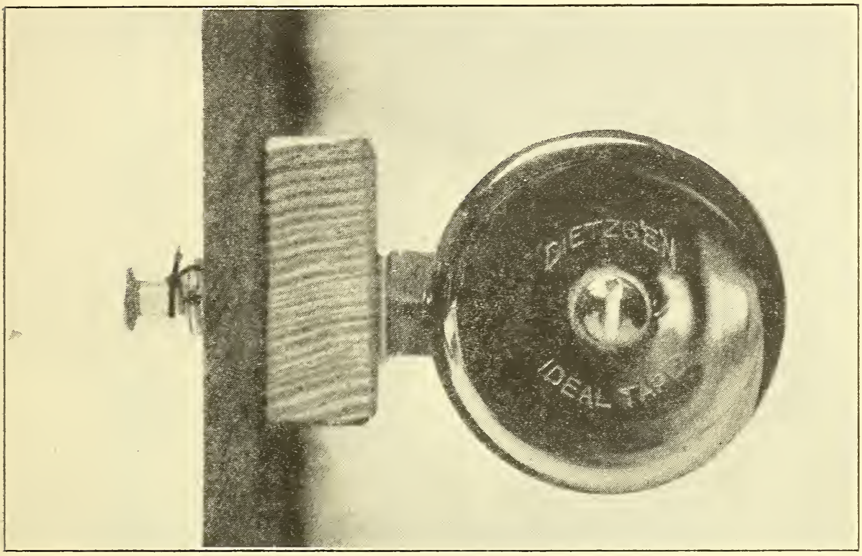

Fig. 4

spring pulling the string inside the spool. The tube screws into the spool, so is removable. The open end of the tube is slightly enlarged into a smooth rim which prevents the tube pulling through the mounting when inserted from the front. In mounting these on a map board, a hole of exactly the same diameter as the tube is centered at the lookout location on the map. The tube is unscrewed and inserted into the hole from the front or thread end The string is then restrung through it, a glass-headed push pin attached, and the reel screwed to the threaded end of the tube until it fits snugly against the back of the map board. If the map board is not of thin material, it becomes necessary to put in a block or to chisel out the wood to permit a snug bearing when the reel is screwed upon the tube. On the face of the map, the opening of the tube is inconspicuous. At the back of the map it is desirable to provide a protecting frame to avoid bumping the

reels. A sample string reel mounting is demonstrated by the attached photographic print.

These reels have been used in the development of seen area dispatcher maps for all Region 5 National Forests.

I should like to recommend that six of the new "J" axe brush hooks, of the design shown in the accompanying sketch (Fig. 7) be substituted for that many of the double-bitted axes now in the 25-man outfits for fire fighting. My trail men have used these "J" axe brush hooks nearly all summer and found them to be the best tool of its kind put out. They state that the axe portion is just as efficient as a double-bitted axe and also the best brush hook yet made.—District Ranger F. E. BROWN, Cabinet.

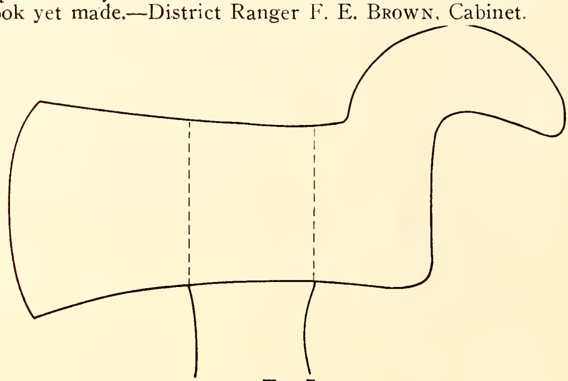

FIG. 7

A DIFFERENT FIRE LINE PLOW PRINCIPLE

Two illustrations (Figs. 5 and 6) are given of a new type of fire line plow developed during the past season on the Superior National Forest. The wavy looking outer edge of the vertical portion of the wheel is sharp (for cutting) and is composed of a very hard metal welded to the outer edge of the steel. Although the pictures do not so indicate, Superior plow changes are fairly difficult. The hitch mechanism, a vital point with this

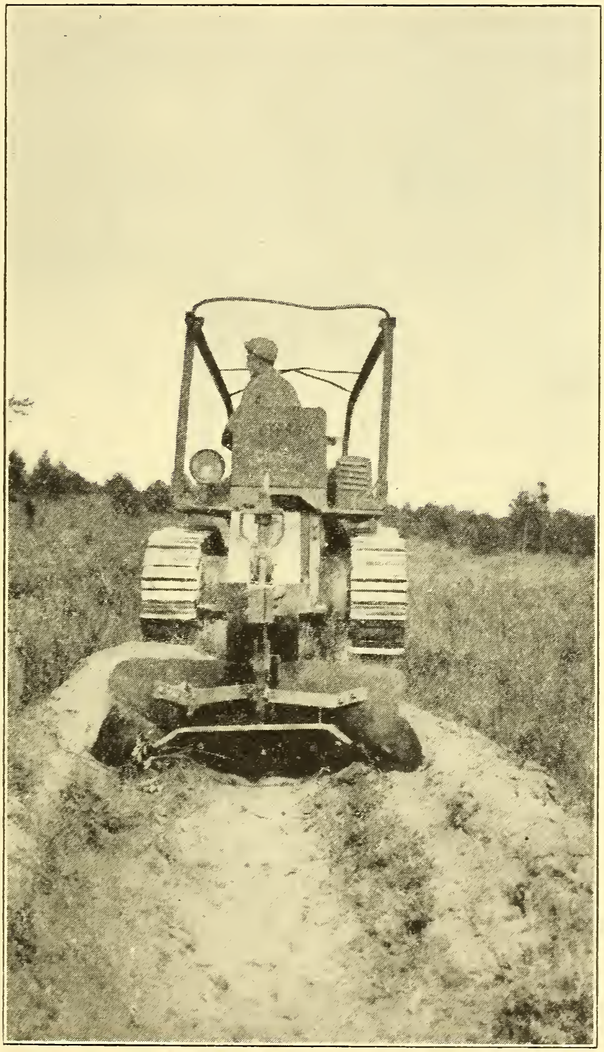

Fig. 5—Type of furrow produced by plow. Action is very similar to Killefer 77. In this particular type of plowing the Killefer 77 cannot be drawn faster than in second gear. This plow will travel in high. The picture also shows construction detail of moldboard assembly from rear. Stability is indicated in this picture.

type of plow, has not been worked out satisfactorily. The hitch finally used will probably be similar to that employed with the Region 6 fire plow.

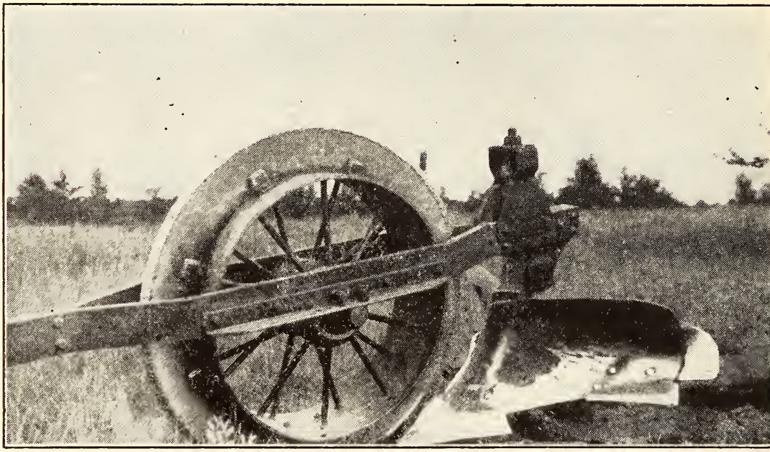

Fig. 6—Side view of Mesaba plow, showing construction details of moldboard assembly. It will be noted that the assembly has a vertical adjustment, although the picture does not clearly indicate this point. It may be seen that the wheel axle has the vertical adjustment. The cutting rim is resting on a block and is, of course, not in its natural position. The type of cutting fins which it is hoped to develop are shown attached to the moldboard.

SWEEPERS FOR LINE CONSTRUCTION

J. H. Bosworth

Assistant Supervisor, Cabinet National Forest

Assistant Supervisor Bosworth, of the Cabinet National Forest, is proposing to revive the sweeper machine idea which has lost out so far in competition with schemes for making fire line with plows and brush busters. His statement regarding one type of sweeper machine for line construction follows.

My latest idea of this machine is to use about a three horsepower gasoline, air-cooled motor with an encased flexible drive shaft on which is attached a flexible steel brush about 12 inches in diameter and about 16 inches long, shaped like a bullet. Between the motor and drive shaft there would be a transmission with reversable gears. Flexible drive shafts of 7/8 inch 6 to 8 feet long can be purchased from regular stocks, and a shaft of this size will handle a 2 H. P. motor.

The machine should be made portable, and all parts possible should be made of aluminum or some other light metal.

WHAT ARE VISITORS TO LOOKOUT POINTS INTERESTED IN?

Visitors to lookout points are relaxed and in a receptive frame of mind. A skillful lookout man has a perfect chance to imprint permanently the habit of care with fire in the woods. How shall he do it? Well, what is the visitor interested in? That should give a good starting point for formulating effective ways of spreading the gospel of fire prevention. Here is a list of every-day questions the visitor asks, according to a lookout man on the San Bernardino National Forest in California:

Now that I am up here how will I get down?
Why haven't you an elevator?
Can we have a drink of water? Can we have a glass?
Is it always so hazy? Is it ever clear
Does the wind always blow? How hard does it blow?
Oh! Do you live here?
Can we sit on your bed? How can you sleep on that bed?
Does the tower sway much?
How high are we? What is the elevation?
How high is the tower?
How many men are there on duty, 2 or 3?
How many hours do you watch? Do you look at night?
How many months do you stay here? Or—Do you stay here all the time?
I suppose they give you your vacation during the winter?
How do you get this kind of a job?
How many days do you get off?
Who brings up your water and supplies? Or—How do you get them?
Do you ever get lonesome?
Could a man have his wife with him?
Can we use the binoculars? The telescope?
What is this instrument and that instrument?
How can you see when the shutters are down?
When is the best time to come up to see the view?
What time is sunrise and sunset?
How many stations like this are there?
Do you have a telephone?
Do you ever see any fires?
How long must we wait to see a fire?
Where is Lake Arrowhead? Do they use the water for irrigation?
What is this peak and that peak? This range and that range? This place and that place? This tree and that tree?
Can you see Big Bear Lake? Can you see the desert? The ocean? Catalina? Los Angeles? How far can you see?
Were the firebreaks made by the CCC's? Where are the CCC Camps located? Are the CCC's any good?
Does it snow here?
Do you see any deer? Bear? Lions? Rattlesnakes?
Will a mountain lion kill a person? Where can we see a deer? A lion?
Does it ever lighten? Does it hit here?
Where are the Twin Peaks?
Do you have to fight fire?
I suppose you spend most of your time reading?

What do you do with all your time?
Who cuts your hair for you?
How can you take a bath in a glass house?
Do you have a horse?
Are you a ranger? What is the difference between a ranger and a forest guard?
Can you get anywhere being a forest guard?
What is the pay? Can you get married?
How do you find a fire? How far can you see a fire?
How can you see smoke in this haze?
Who cleans your windows for you?
What is the electric fan for outside?
Do you have a radio? What would you do without it?
Do you talk to yourself? May we play the radio?
How cold does it get? How warm? When does it snow?
Aren't you afraid the tower will blow over?
Do you have an aspirin? Any soda?
Can we eat our lunch in here if we take our papers with us?
Do you follow this work because you like it or do you have asthma or something?
What do you do in case of lightning?
Where can I get some wood for my fireplace? Stove?
Is it true lightning never strikes twice in the same place?
Can we smoke here? Do you have a match?
Is the lake natural? Does it look like an arrowhead?
Do you signal the airplanes? Do you send weather reports to the airports? To the airplanes?
Is it going to be a hard winter because there are lots of pine cones and acorns and the squirrels are fat?
Can we take our clothes off to take a sun bath if we go behind the rocks?
Are there any nudist colonies around here?
Has anyone ever fallen off?
How much rain do you get? How much snow?
How come all that brush is included in the National Forest?
Can we read your diary?
Is that mountain out in the valley where the smoke is a volcano?
What are the three balls going around on that post down there for?
Is that can a rain gauge?
Do you have electric lights?
Does the Government give you your uniforms, or do you have to give them back when you are through here?
Can we tie our horse to the tower?
Does the Government furnish your supplies?
Can you shoot deer whenever you want to for your meat?

THE ETHICS OF WOODS BURNING—A KEY TO PREVENTION

W. I. White

Forest Service, North Central Region

It seems to me that we have been pretty generally overlooking what is probably the most potent force available for real fire prevention. This force, if once aroused, will accomplish more thorough and permanent results with many people than all the arguments commonly used in preaching fire prevention. I mean the ethical sense of right and wrong.

In many parts of our forest domain, particularly in the lower Mississippi and Ohio valleys, the economic status of the rural residents within the forests is very low. It has traditionally been so, and in spite of our various plans for social uplift, the thinking and habits of a community cannot be changed over night. Discussions of economic betterment, land use planning, conservation of resources, etc.. are often entirely meaningless to an Ozark mountaineer who has been taught from the cradle to believe that what was good enough for his "pappy" is good enough for him.

On the other hand it has been amply demonstrated and reported that the residents of many of these communities of low economic status have a very deep and forthright religious feeling. Even though they may not be able to discriminate between good and poor farming practice, between wasteful and conservative use of land, they do have a well-defined sense of right and wrong.

Why not, then, elevate our consideration of woods burning to an ethical plane and consider it from the standpoint of right and wrong? A man who may not be able to see any economic advantage in allowing his woods and fields to go unburned may perhaps be brought to feel a sense of stewardship for the natural resources which the Lord has placed at his disposal. Or, allowing a fire to damage his neighbor may be placed in the same category with stealing his neighbor's cow. Throwing down a burning match or cigarette by the roadside may be likened to doing the same thing in a powder magazine.

As a means toward establishing this principle in the communities where woods burning has been done deliberately for many years, I suggest that our field men make it a point to cultivate the acquaintance of the preachers who work in the forest communities, attend their religious meetings, and definitely align themselves with the apostles of right and truth. I be-

lieve that by tactful contacts the matter of malicious or uncontrolled woods burning can be brought out into the open and mentioned specifically in meetings of this kind as an unethical thing to do, the same as lying, or stealing, or beating one's wife.

There is no question about the preacher being a leader in the sort of community of which I speak, and the local Forest Officer can make no mistake by being definitely and clearly on his side.

Certainly if the deliberate or careless setting of fires can be given a definite stamp of disapproval by the right-thinking people in any community, many other acts of trespass and evil-doing which give our law enforcement officers gray hairs will be greatly reduced also. Let's give it a trial!

According to a clipping from the Boise, Idaho. Statesman of October 12, 1936, the Boise National Forest has installed a 1,495-pound periscope on Shafer Peak to assist in locating blazes. The periscope was borrowed from the United States Navy. A week ago several small fires were located 40 miles away with the periscope. The idea of Navy periscopes on lookout peaks is interesting. We hope the Boise National Forest will tell us about it in the next issue of FIRE CONTROL NOTES.

PREVENTION OF RAILROAD FIRES ON THE CABINET NATIONAL FOREST

A. H. Abbott

Forest Supervisor

The Cabinet has the decidedly unenviable record of having had more railroad fires in the past few years than any other Forest in the Region, and possibly more than all of the others combined. However, through active efforts to secure compliance by the Northern Pacific Railway Company with the terms of the agreement of September 26, 1921, the loss during the past few years has been very greatly reduced. The number of fires, both reportable and non-reportable, has been reduced by better than 85 per cent (the percentage being based on the number per train), and the interest of the railroad officials has been greatly increased. Since fire suppression charges are paid by the Northern Pacific Claims Department, other employees were formerly not concerned, apparently, with keeping those costs down. This attitude has been changed. The railroad officials are doing their best to improve their spark arrester devices, and are now seeking ways and means of determining if fires are due to failure of personnel rather than failure of the spark arrester devices.

Regular inspection trips along the right of way are made by Forest officers and railroad officials, and the annual meetings are not merely meetings to comply with the terms of the agreement, but meetings to devise ways and means of bettering fire prevention. The Forest Service has emphasized the value of fire prevention as an insurance against fire suppression and fire damage costs. We are also trying to put across the idea to the railroad that fire scars along the right of way are not attractive to the passengers.

The time spent by officers of the Cabinet in such prevention and presuppression work, through which the Northern Pacific Railway Company is benefited, has been brought to the attention of the railway officials, and since the company is responsible for right-of-way fires, efforts are being made to reduce Forest Service costs and have the company redeem its responsibilities.

We have mentioned the above at some length, since visitors from other Regions, where considerable trouble is experienced with fire-setting engines, have expressed considerable interest, and have taken copies of the Northern Pacific agreement, to see if some sort of similar agreement could be worked out with other railroads.

EXTRA PERIOD FIRES

A. H. Abbott

Forest Supervisor

Our "pet peeve" has been extra period fires. We feel that suppression costs must be given consideration. After all, we are fighting these fires with taxpayers' money. If we have fires, as we frequently do, where there is no particular danger that such fires can spread, and where, by delaying action a few hours, we can avoid sending men into dangerous, craggy country without trails until daybreak, or avoid sending special fire suppression men when a trail crew or other crews in the course of the regular travel can reach them within a reasonable time, we believe that it is foolish to send in men solely for the purpose of suppressing such fires in order to keep them from being classed as extra period. Understand, we do not want to take any chances, but there have been a number of cases where delaying action has meant an actual saving in dollars without any chance for such fires to be over Class A size.

ONE WAY TO SUPPLEMENT FIRE CONTROL INSPECTION

M. B. Mendenhall

District Manager, Cabinet National Forest

Inspection problems bother executives responsible for inspection as well as the inspectors. How can the time be found for keeping up with inspection standards and schedules? How can the training content of inspection be increased? Do inspections merely worry inspectors or are they welcomed? When a fire executive desires more certainty that preparedness is at a higher level than he can attain by personal inspection, what can he do? A busy District Ranger gives a practical answer.

On the Plains District during the months of July and August there were 25 outlying camps which, under the weather conditions experienced, we found impossible to inspect more than once, except for a few early points, or where the need for emergency trips was clearly shown. To keep in closer touch with conditions a system of telephone inspections was initiated.

This inspection outline was made up from a list of things that were found wrong on previous inspections. A form was made up according to the attached sample. The following items were checked in detail:

Map reading, detection tests, and training.
Knowledge of country and trails.
Watch, time, and accuracy.
Check reports for adequate supply and proper use.
Diary, have lookout read certain days and suggest betterments.
Precipitation records.
Wind gauge, condition, care of.
Training visibility judgment.
Observations, how made, when.
Regular and special instructions.
Patrols, are they being made? When?
Lightning strike observations, follow up.
Azimuth back sights.
Fire pack, check items and condition, compass tied on pack, light, batteries, water bag soaked, etc.
Night lights, gasoline, batteries.
Telephone, condition, installation.
Lightning protection, house and telephone.
Condition of ground.
Extra rations.
Mapboard.
Windows, clean?
Wood supply.
Water supply.
Condition of grounds.
Maintenance needs.
Sanitation.
Subsistence supplies, when will new supply be needed?

This list may, of course, be supplemented or condensed to what each Forest officer judges necessary to make a proper check of the point.

It was found that the time necessary to do this job varied from 20 minutes to one hour per position, averaging about 45 minutes. Frequency of

inspections was set at once each week. Inspection by telephone was cancelled for the week when an actual inspection was made of the point. Time necessary to carry out this work required about two hours per day for office force. Much of it has to be done in the evening on account of fire work during the day.

Although I anticipated good results from this systematic check of points I was amazed by the benefits which immediately became apparent. The men became intensely interested and on their toes, and even inspected themselves and called up for information and advice. I even overheard telephone conversations in which lookouts were conscientiously inspecting each other. Within a short time we had one of the finest examples I have ever seen of a large organization of temporary men working together to handle a difficult job.

That this system showed results was ably demonstrated by the almost military discipline, coupled with individual initiative, shown in controlling the disasters that occurred in Plains on September 4.

While I do not claim that telephone supervision can possibly equal field inspections, I do feel that when it is clearly impossible to contact lookout men at their stations at desirable intervals, we can accomplish a great deal by a systematic schedule of telephone contacts.

PUBLISHED JAN. 1937

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

FIRE CONTROL NOTES

Number Two of a Series of Publications Devoted to the

TECHNIQUE OF FIRE CONTROL

The value of these publications will be determined by what you and other readers contribute. Something in your fire control thinking or work would be interesting and helpful to others. Write it up and give other men some return for what they have given you.

Articles and notes are wanted on developments of any phase of Fire Research or Fire Control Management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting methods or reporting, and statistical systems. Whether an article is four lines or ten typewritten pages in length does not matter. The only requirement is that articles be interesting and worth while to a reasonable proportion of readers.

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FIRE CONTROL NOTES

JANUARY, 1937

Forestry cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and technology may flow to and from every worker in the field of forest fire control.

SOME GENERAL PRINCIPLES OF RATING FIRE DANGER

H. T. Gisborne

Senior Silviculturist, Northern Rocky Mountain Experiment Station

Many disasters have occurred because, with unaided judgment, fire control executives were unable to size up accurately the effect of a creeping increase in fire danger. Nothing can replace trained judgment in fire control management, but judgment needs every possible aid which can be provided. The author, a pioneer in the field of danger rating, outlines some principles which have been followed in developing the first adequate system for aiding judgment by measuring and integrating the elements of variable fire danger.

Although the measurement and rating of forest fire danger have been developed, tested, and found useful in Region 1 during the past few years, conditions in other parts of the country probably are such that different methods may be found preferable there. A few general principles, however, which have affected the results in Region 1 would seem to apply elsewhere.

Basic to fire danger rating is the recognition that fire danger as a whole is composed of two distinct parts: the relatively constant factors, and the decidedly variable or temporary factors. The constant factors include principally, slope, density, and character of cover type, exposure to prevailing winds, and the size, quantity, and arrangement of the fuels. These factors, together with the *normal* activity of the causative agencies, as illustrated by "spot maps," indicate the need for permanent fire control facilities and the strength of man-power that must be planned for use over a long period of years. These factors are relatively constant on any particular area. They differ from place to place.

The variable or temporary factors of fire danger include all those conditions which make one fire day or one fire season different from another in a particular ranger district, forest, or region. These factors differ from time to time. In Region 1 they include such conditions as the luxuriance and inflammability of green vegetation, the moisture content or inflamma-

bility of dead fuels, the wind velocity, occurrence of lightning storms, prevalence of debris disposal fires in and around the forest, the visibility distance, etc.

Efficient fire control at least cost obviously depends upon sizing up these constant and temporary danger factors, and building and operating a fire control organization accordingly. The progress of the past few years in sizing up these factors has been in recognizing the fact that each of them should be measured, instead of guessed at. The principal impediments to this progress have been the multiplicity and complexity of the factors, and the difficulty of measuring some of them.

The first principle of rating temporary fire danger is to identify all the significant variable factors. Identification can be readily commenced on the basis of the consensus of opinion of experienced men, because there are in every region a few outstanding factors. For many years attempts were made to find some *one* factor, but the present state of our knowledge shows that there are usually several. The first step is, therefore, to select those generally recognized by competent men.

One variable not yet included in the Region 1 method is the greater dryness and inflammability due to cumulative drought lasting over months and even several consecutive years. Its importance, during critical years at least, is recognized, but we do not yet know how to measure it.

After selecting the significant variables on the basis of experienced judgment by many men, there are two research tasks: first to check these factors by experiment and by test; second to devise methods of measuring each of them. As a rule, wholesale testing is dangerous during the developmental stage because uninterested and incompetent men will not make a fair test and will become prejudiced against the method if it seems to fail. Many years may then be required to overcome this initial prejudice even after a satisfactory method is devised. We are all "built that way," and we might profit by recognizing it. The development of methods of measuring each selected factor is a marked opportunity for all the ingenuity that can be brought to bear, and there is lots of ingenuity in the Forest Service.

The second principle of measuring fire danger, obviously, is to make these measurements represent the entire forest property. If the measurement stations are all located in the hottest, driest, windiest spots the results, when combined, will not represent the entire property. There again, it is necessary to consider another natural, human tendency, and that is the inclination to protect oneself. The Forest officer reveals this by trying to show high fire danger for his property, but he wants other Forest officers to be "fair and reasonable" by showing theirs correctly. The location of

fire danger measurement stations must be watched with this in mind. Periodic comparisons of data soon uncover the individuals who think that they benefit by measuring *only* their worst danger spots.

No guiding rules of how many stations per unit of area, or location of stations by altitude or timber type have yet been discovered in Region 1 to assist in the proper sampling of the forest property. Our policy has been to increase the number of stations slowly until the results indicate that commensurate, additional benefits are not obtained by adding more stations. A large field of work remains to be explored here.

The third principle of measuring and rating fire danger is that the net effect of the several significant variables must be determined by such a method that all men applying the method to certain data will arrive at the same answer. For example, if wind and fuel moisture alone are selected as the significant variables, and if wind is broken into five significant classes and fuel moisture into five stages then there will be 120 different combinations possible. If in addition there are three stages of vegetative readiness to burn, or resistance to being burned, there will be 720 combinations possible. Even if these 720 combinations actually produce only six or eight significantly different classes of fire danger the accurate integration of factors is too complex for the ordinary individual.

The integration of effects of the several factors must therefore be made by use of tables, charts, or mechanical devices such as the R-1 Danger Meter, if the measurements of the selected factors are to be used consistently by all men. Region 1 uses the danger meter device merely because it seems to be the most convenient and least bulky method. By making this device in pocket size its daily use for reference was encouraged.

The rating of fire danger produced by the integrating device must be in numerical terms if the ratings for days, seasons, districts, and forests are to be added and averaged. Terms such as "easy," "average," "bad," etc., cannot be so used. The range of the numerical scale does not seem to be important except that there is little use in defining 100 degrees or classes of fire danger, but there is a practical need of identifying each class which does or may require distinct administrative action. When the first fire danger meter was evolved, in 1931, seven classes of danger seemed like over-refinement. Today, the supervisors and rangers of Region 1 are distinguishing between a low, middle, and high class 4, class 5, and class 6, and they build up or decrease their forest protective organizations accordingly. Actually they are thereby recognizing from 13 to 15 classes of

danger, but the seven classes still serve adequately to differentiate the major organization steps specified by the fire plan.

As already indicated, the number of classes may well be suited to the number of steps the protective organization is likely to distinguish. Application of the danger rating scheme is thereby facilitated by specifying the size of organization force that is warranted for each class of danger. This can be done only tentatively, of course, until the scheme has been given careful field trial over a period of years.

One year of development, in the hands of a few of the most interested field men, and three additional years of gradually extended field trials were necessary in Region 1 before these methods were deemed sound enough to be made official practice. They have been in official use on the fire forests for two seasons. They are now being extended to the less critical forests.

Write It!—And write it plainly! Existing instructions set forth the importance of *written* messages in fire control work, but this is a matter which cannot be overemphasized. The memory of no man, no matter how trustworthy, is infallible. Add to that fact the drug of weariness, the imagination of excitement, and the sickness of heat exhaustion, and it can readily be appreciated why verbal messages should be avoided like the plague.

The written signed message establishes beyond doubt the author thereof, the responsibility of the man on the receiving end, and insures the content against the least change.

It is also very desirable to make a message complete. When sending for reinforcements give best estimate of the size of the job as well as the number of men desired. A truck driver or other messenger is likely to bring in a wild story of "the whole country's afire" with a message reading: "Send ten men—Jones." The question immediately arises as to whether Jones actually knows how big a job is in front of him. A better message would be: "Dispatcher. Fire north end Bell Mountain, approximately 40 acres, spreading slowly. Send ten men reinforcement crew and will be able to corral fire an hour after their arrival.—Jones." Think how a message like that would warm the cockles of a harassed ranger's heart! So let's write it, boys, and write it plain.—*Harley H. Thomas, Forest Ranger, Clark National Forest.*

WHAT RATED FIRE DANGER MEANS IN REGION 1

C. S. Crocker

Fire Inspector, Region 1

When fire control management declines to accept the results of fire research there is room for debate as to who is wrong—management or research. But when management seizes upon and applies the results of research, the first and hardest test has been met. What management thinks about Gisborne's danger meter is expressed by the author in no uncertain terms.

"Feeling it in your bones" has long ago passed out of use as an adequate means of rating fire danger. Whether Kapoks and limousines have exterminated the rheumatic germ which made possible this lost art is not known nor is it worth our while to attempt a rejuvenation of this antiquated technique.

Time and fire control have marched on—the former in orderly uniformity, the latter in more or less sporadic spurts of progress accomplished through maneuvers founded too often upon guesses. Reversals, too, have been experienced to the extent that our record indicates a deficiency in the element of lucky guesses and hunches. Recognizing the fallacy in continuance of such a practice, fire control managers cast about for a new means of determining fire dangers by which the guessing element would be reduced to a minimum. Success of the many developments pointed toward this objective has been hindered by the reluctance of men to substitute the mechanical for the human element in calculation of dangers.

In the past, our calculations have been based upon current observation and past experience. Too often we did not see alike, and our experiences have varied accordingly. Consequently, our predictions, in many instances, have been influenced by experiences peculiar to individual rather than common factors. We all have some scheme for rating danger. In any group of a dozen men there are at least half as many methods of gauging fire potentialities and a like number of ideas concerning the organization requirements of any particular condition. How can we, as a whole, attain any uniform degree of success when the pessimistic manager overequips while the optimistic manager gets caught unprepared? How can the budget committee equitably allot funds for fire control when it has no uniform rating of dangers existent on individual administrative units?

How can we as guardians of the forest excuse vast suppression expenses

and staggering timber losses attributable to lack of preparedness when we have within our reach means of measuring potential and current dangers? The common "alibi" has been "emergency conditions." Is there such a thing? Except for an unpredicted deluge of lightning fires, there should be no such term as "emergency" in the fire vocabulary. All factors affecting fire behavior, except occurrence, are to a large extent measurable and predictable sufficiently in advance of critical conditions to permit adequate adjustment of protection facilities. We do adjust them, but not consistently with any carefully laid, mechanically gauged, uniform plan. The element of personal judgment carries too much weight in these decisions. After all, what is an "emergency fire condition"? Nine times in ten it is merely the prevalence of high inflammability of fuels and a high probability of occurrence—both measurable and usually predictable. If this is true, then emergency conditions are nothing more than the higher brackets of known danger conditions.

Why not select a few measurable factors having greatest influence on fire danger, assign definite weights to each and combine the coordinated total in a graduated scale of relative classes? These danger classes could then be interpreted in terms of preparedness needs and strength of force requirements. Plans would then specify a prescribed control objective and would provide adequate facilities to meet each class of rated danger.

It is realized that many factors other than inflammability of fuels and likelihood of fire occurrence play an important part in fire control planning. Values at stake, accessibility, character of fuel bodies, topography, and many other components less tangible all deserve consideration in setting up protection facilities. However, these are factors of fairly constant value or risk, and may be assigned weights of reasonably permanent nature in fire plans. These constants designate the intensity of organization, and the location and character of facilities and value to be insured through protection.

Other factors, variable in character, such as dryness of fuels, winds, likelihood of fire occurrence and other elements affecting spread of fire, will determine the time of placing in operation the facilities prescribed by the "constants."

Service-wide use of such a coordinated scheme would bring about uniform treatment of like conditions. Region 1, during the past two years, has

used this method in correlating man-power placement with measured fire danger. It has gone far in leveling off inconsistencies in preparedness expense and has brought about a more uniform and sane treatment of what was formerly termed "emergencies."

Why is some similar practice not feasible on a Service-wide basis?

Assume that we continue to disregard values of destructible resources, and lay our plans to corral every fire within the first work period—we should need as gauges upon which to determine preparedness only those factors governing the spread of fire, difficulty of control, and some measure of the probability of occurrence. These are grouped as follows:

- I. Constants: (Determining place and kind of facilities)
  1. *Fuel inventories*
     - a. Rate of spread
     - b. Resistance to control
     - c. Volume or amount
  2. Topography as it affects fire control
     - a. Maps
  3. Accessibility as it affects mobilization of forces
- II. Variables: (Dictating time and degree of preparedness)
  1. Fuel inflammability
  2. Probability of occurrence
  3. Wind
  4. Visibility as it affects detection
  5. Humidity
  6. Seasonal influence—(long or short burning periods)
  7. Predicted or existing fire-starting agencies

The last group of factors, as used in Gisborne's Danger Meter, are correlated in a manner to show the variation in spread of fire which results from any combination of these elements. Relative danger, as affected by fluctuation of visibility and occurrence conditions, is also incorporated in this rating.

The Gisborne Meter provides for seven classes of fire danger, and while these classes are not graduated in equal sevenths of the worst known condition, each is interpreted in terms of man-power needs and serves as an index for organization placement. Region 1 uses this rating scale as follows:

(All ratings assumed to be within fire season.)

DANGER CLASS	ANTICIPATED FIRE BEHAVIOR	ORGANIZATION NEEDS
No. 1	Brush and other fires do not spread enough to require trenching.	No men specially detailed to fire control.
No. 2	No spread under dense timber or on north slopes. Fires spread during heat of day on south slopes and open areas.	Man special danger areas as slash operations, etc.
No. 3	Fires spread slowly and hold overnight on north slopes and under dense timber—short runs in open and slash. Few crowns except with winds of 24 or more M.P.H.	Man key detection positions —usually about 1/5 average normal midseason force.
No. 4	Fires crown in single trees and small groups but no long runs in full timber on north slopes. Few crowns on south slopes and flats with winds of 18-24 M.P.H.	Complete full average or normal season planned organization.
No. 5	Occasional runs in full timber on north slopes but seldom crowning pronounced topographic divides. Fast spread certain on south slopes, cut-over, and heavily fueled old burns.	Complete manning of one-man protection positions. Place double-up men on key positions. (This formerly was "first emergency" force and equals one-half of the overload fireman organization.)
No. 6	Big runs common all exposures within a single drainage, but only occasional crossing of pronounced topographic barriers (previously known as "second call emergency").	After four consecutive days complete placing all smoke-chaser crews and others planned for "initial" attack.
No. 7	Worst known burning conditions. Explosive fuels—fires spread at 1500-2000 acres per hour, including densely timbered north slopes during afternoon and evening. Topographic and other usual barriers, such as rivers and large cultivated fields, ineffectual during peak of day.	Mobilize supplemental overhead. Organize reinforcements or second line of defense crews. Place in effect the maximum planned protection strength.

The use of this scheme has made possible a uniformity in strength of manning which eliminates much of the erratic organization practice of the past. Why can it not be adjusted to fit the needs of all fire Regions and thus provide a uniform basis for planning, organization, treatment of similar conditions, and perhaps for the allotment of protection funds?

Under this plan there is no "emergency condition." The top brackets of fire danger are merely recognized and planned for, and no longer are considered outside the range of probable occurrence. Such conditions are identified through mechanical measurements, are graduated on a mathematical scale, and are classified according to severity in scales which are interpreted in protection needs. Guessing and "feeling it in your bones" are reduced to the minimum. Should it be so?

TWO WAYS TO IMPROVE DETECTION

I. M. Varner

Administrative Assistant, Boise National Forest

How much lost area is due to slow detection? We probably will never know. But when, as we do know, cold analysis credits primary lookouts with a very bad score in "first discoveries," it seems we should do something drastic to improve their batting average. The method presented in this article, supplemented by the systematic patrol detection in blind areas, should shorten discovery time appreciably.

Study of past fires on five Idaho forests, Region 4, shows:

(1) The primary lookouts have made first discovery of an average of 30 per cent of the total number of fires.

(2) Some fires have been class "B" when discovered.

(3) The size of fires upon arrival of first line of defense too often ranges from large class "A" to small class "C."

(4) Discovery time is greater than it should be in seen area.

(5) Fires which have long discovery time often develop into class "B" and class "C."

(6) Observation by lookout has not been systematically done.

(7) High hazard and fire danger areas do not obtain sufficient searching observation by lookouts to insure discovery of fires at the earliest time sufficient volume of smoke makes discovery possible.

With the objective of obtaining better and more certain detection by lookouts of fires when they are small, reduction in discovery and elapsed time, increase in the percentage of first discoveries by lookouts, decrease in size of fires upon arrival of first man, and reduction in burned area by accomplishing suppression while fires are small, a plan was devised and used on the Boise National Forest during 1936, designated as the "Synchronized Sector Observation Plan for Lookouts."

Synchronized Sector Observation Plan

In an effort to obtain better detection, especially of small fires soon after they start, the following plan has been designed to obtain more systematic detection, eliminate factors of uncertainty and increase the individual and combined effectiveness of the lookouts:

1. The area from each lookout is divided into five sectors to be allotted an equal time for searching observation.

2. Each lookout's sectors are numbered in rotation to agree with the sequence of observation.

3. All lookouts' sector observation rotations are synchronized so that

each area is under observation from some lookout at least twice during the rotation period.

4. An observation record will be kept by each lookout when sector observation is effective.

5. The sector schedule can be used by the dispatcher once each hour, or when deemed necessary.

6. The sector observation period can be any length of time desired—3, 4, 5, 6 minutes, etc.

7. When sector rotation is not effective the lookout will follow the old method of observation.

8. Sector schedule can be arranged by groups of lookouts for midday meal period so that observation is had, one group to have meals at 12:00 sharp, one at 12:30, and one at 1:00 p. m., or whatever schedule seems best.

9. The sector method will call for a searching study of the sector concerned to insure detection of small smokes, difficult to detect by casual observation.

10. This system will insure that all seen area will be covered by searching observation during the rotation period.

11. The rotation schedule is arranged so that the high hazard and danger areas obtain more frequent observation than areas of lesser degree of hazard or danger.

12. It is a systematic method of observation and an effective tool for the dispatcher, a means of giving limited and definite responsibility to each lookout. It provides a means of checking upon the ability, diligence, and effectiveness of each lookout.

Prior to the beginning of the fire season a map was prepared upon which the sectors for each lookout were laid out, numbered one to five to agree with the sequence of rotation desired for each lookout, and the visibility map on the fire finder of each lookout was marked with the sectors and their designated numbers to agree with the master map.

All lookouts' sector observation rotations were synchronized so that a maximum concentration of observation was had on all high fire danger and high hazard areas.

Each lookout was required to keep a record showing the exact time observation started and ended in each sector, recording by azimuth readings all smokes, dust clouds, fog banks, etc., observed in each sector.

Because of the fact that 1936 was the second most severe lightning fire season of record on the forest, it was considered necessary to have lookouts concentrate on areas in the path of the storms for periods of several hours to several days in order to detect fires where strikes were known to have occurred and where holdover fires were probable because of heavy local rains. For this reason, and because the plan was experimental, it was used to a limited degree.

The schedule for sector observation was one complete rotation by each lookout from 9:00 to 9:20 a. m., 11:00 to 11:20 a. m., 1:00 to 1:20 p. m., 3:00 to 3:20 p. m., 5:00 to 5:20 p. m., and 7:00 to 7:20 p. m. This schedule gave synchronized sector observation for 16⅔ per cent of the daily observation period.

Under the schedule a four-minute period of searching observation was required of each lookout for each sector; thus at 9:00 a. m. each lookout started a searching observation in his sector number 1, at 9:04 a. m. he moved to sector 2, leaving it at 9:08 a. m., and so on through the five sectors completing the rotation. Between sector observation periods the lookout was free to follow the standard observation practice of completing the search of his territory once each 15 minutes.

Considerable experimenting was done relative to the most desirable length of sector observation period, using 2, 3, 4, and 5 minutes each period for each 72° sector. The four-minute period was finally decided upon as giving the best results.

As a means of enforcing the rigid use of the sector plan by each lookout and as a check on effectiveness, smoke candles were used. These tests showed that 95 per cent of the test smokes were discovered by the lookouts within the four minutes allocated for the sector in which the smoke was placed and by the lookout in whose sector the smoke was started, under fair visibility conditions up to a distance of nine miles.

The plan was placed in actual use on the forest as a whole on July 17 and continued to October 7, 1936.

The first discovery by lookouts for the period was 47 fires. Twelve of these were discovered under synchronized sector observation, which amounts to 25 per cent of first discoveries being made while lookouts were making observations under the sector plan which was in operation 16⅔ per cent of the daily observation period.

The discovery of 16⅔ per cent of the fires under this plan would have indicated only normal detection and the record of 25 per cent first discoveries shows an increase of 8 per cent above the normal, indicating that

the sector plan of observation produced substantial results.

The use of the sector plan had a very marked influence upon the efficiency of the individual lookouts. The psychological effect was to create a more definite feeling of responsibility; to accomplish detection of fires at the earliest moment the smoke became visible; to make a thorough and systematic search throughout the daylight hours. Many of the lookouts voluntarily followed the sector observation scheme during most of each day when not required to do so, and all of them expressed approval of the plan as the most effective method used up to this time, recommending that the plan be used throughout the entire daily period of observation next season.

A study of the forest detection record for lookouts for the period 1922 to 1935 inclusive shows an average first discovery by lookouts of 43 per cent of all reportable fires.

The 1936 record was 49 per cent of discoveries by lookouts. This is an increase of 6 per cent, and when consideration is given to the size of fires upon arrival of the first man, which was 18 acres for the total 130 fires, and the final area, which was 24½ acres, the detection record is remarkably good.

There have been 117 class "A" and 13 class "B" fires on the forest so far this year—75 were lightning fires and 55 man-caused fires.

In connection with detection studies this year it was found that many small class "A" fires did not produce smoke in volume equal to that of a forestry smoke pot for several hours after the fire had started, and that the lookouts discovered nearly all fires as soon as the volume of smoke made it possible for them to be seen. It seems that we must take the size of fires upon discovery, and more especially upon arrival of the first man, as one of the measures of the efficiency of lookouts, as well as the discovery time based upon time of start, which is usually a guess.

The discovery of man-caused fires by lookouts has been very low over a period of years, and the increased efficiency in detection of this class of fires is very desirable. The lookouts on the Boise Forest averaged 22 per cent first discoveries of man-caused fires for the period 1922 to 1935 inclusive.

The 1936 record shows 31 per cent first discoveries, an increase of 9 per cent, which is a substantial improvement.

Experiments in the use of the sector observation plan this year showed that it should be more flexible to changes caused by the addition or removal

of lookouts, and a master control map was prepared for use by the dispatcher. This map was made by placing a small shaft through the map backing, which was one-half-inch cellotex backed with one-inch lumber, at the central point in the protractor for each lookout. On the face of the map a two-inch arrow was fastened to the shaft, and on the back each shaft was fitted with a one-and-one-fourth-inch pulley. A single control was then placed in one corner of the map by having a shaft through the map and its back board with a one-and-one-fourth-inch pulley on the back end of the shaft and an arrow and control knob on the front end of the shaft, which centered through a protractor secured to the face of the map.

All protractors, including the control protractor, were then marked off in five 72° sectors with numbers 1 to 5 on the sectors of the control protractor.

A small endless belt was then placed over the pulleys so that when the control arrow was rotated each of the arrows of the lookouts rotated with it. Arrows are removed from lookouts not occupied from day to day so that the map represents the actual detection setup existing at the moment.

By moving the control arrow to any sector the arrows of all lookouts move into corresponding sectors.

This device makes it possible to study detection in detail each day and to synchronize the rotation of the lookouts and the order in which each sector for each lookout is to receive observation. This control map shows at a glance the sectors and area under observation by each lookout individually and all lookouts in combination for each sector observation period.

The results produced this past season showed sufficient benefits in favor of the use of the Synchronized Sector Observation Plan to justify putting it into full use, which it is planned to do for the 1937 fire season.

Detection-Patrol Plan

The lookout system, at least as far as the Boise National Forest is concerned, does not provide adequate detection for the blind areas, where our greatest man-caused fire danger exists, and which, as a rule, are traversed by roads or trails.

Studies of the visibility map for the forest showed that 40 per cent of the forest is blind to the regular lookouts, and that 65 per cent of this area is in the deep canyon troughs traversed by roads or trails and is high hazard country. We set up a study to determine the additional lookouts needed to cover these areas and found the cost would be prohibitive under present conditions. As a result of this study we formulated the Detection-

Patrol Plan, which was outlined as follows:

1. For blind areas, such as the deep troughs of the Boise and Payette Rivers, detection in addition to that provided by the regular lookouts is necessary.

To accomplish this the emergency guard placement plan will provide for placement of men to serve as detection-patrol, setting up a definite patrol route, and selecting definite observation positions on and along this route from which the patrolman will make observations on a definite time schedule. This system will insure that the patrolman is actually making his assigned patrol and observations.

Each observation point will be equipped with a telephone line drop for connecting a field phone, or in case the route is not served by a telephone line, a radio antenna will be set up. Each patrolman will be equipped with either a field phone or portable radio set, or both, in accordance with the demands of his patrol route, so that he can be in scheduled contact with the dispatcher or ranger while on patrol.

2. Some of these observation points will be equipped with a fire finder and will be tied in with the lookout system to facilitate location of fire.

3. This plan will give detection in the blind areas once or twice each day, or whatever number of observations are considered necessary.

The detection-patrolman will contact the public along his travel route, give the required detection service, and be tied in with the control organization by communication so that he will be a mobile unit for first line of defense in fire suppression.

It is contemplated that this method will give maximum service, as contrasted with the use of additional emergency lookouts to provide detection in blind areas.

4. The maximum number of detection-patrolmen necessary for the critical period of a critical fire season has been set at 22 for the forest proper and 5 for the Southern Idaho Timber Protective Association area.

5. The number of detection-patrolmen to be placed, the routes to which they will be assigned, and the time of placement will be decided by the supervisor.

6. Each ranger will construct telephone line drops and install radio antennae at each observation point on each patrol route set up for his district, as called for in the graphic plan. This will be done prior to the date the route or routes are to be occupied.

7. The dispatcher and rangers will set up a patrol schedule, giving the time each patrol starts and ends each day, the time the patrolman will check in from each observation point, and the time check-in will be made from other stations or locations along the route.

8. The dispatcher will keep available for ready use a map showing all of the detection-patrol routes and points for observation, indicating whether they are equipped with telephone drop or radio antennae, and the headquarters station of each patrolman.

Each ranger will be supplied with a map showing the information for his district.

In developing this plan a fire occurrence map tracing was placed over a visibility map for the forest and the fires spotted on the visibility map on all of the blind areas. On this combination fire occurrence and visibility map sufficient lookout points were designated and marked to cover the blind areas. This latter job required a visibility survey.

After locating these points close to the travel routes, patrol routes were laid out and marked with a heavy line in a separate color for each route. The observation points were then given a symbol indicating the means of communication from the position. These symbols were made in the same color as the patrol route designation. With this done, the seen area from the selected observation points was colored the same as the patrol route, and last the headquarters symbol in the same color was placed on the map for each patrol route. This procedure was followed for all blind areas, resulting in a graphic plan which showed patrol routes, headquarters for patrolmen, observation points, seen area, and means of communication for each observation point, headquarters, and check station.

The completed plan provided detection for 70 per cent of the area blind to lookouts.

During 1936, which was a normal fire year, only nine of the detection-patrol routes were regularly used, and six of these were manned by regular guards. During critical weekend periods, when exceptionally heavy travel entered the forest, and during severe lightning storm periods other designated detection-patrol routes were manned by guards, rangers, and CCC foremen, to provide the additional detection and public contacts deemed necessary.

These detection-patrols made first discovery of 14 man-caused fires and 12 lightning fires during 1936, which amounted to 23 per cent of the total number of fires occurring during the period for which they were in service.

All except three of these 26 fires were in country which was blind to the regular lookouts.

The men on these patrols went to and completed suppression of 25 of 26 fires; 25 of these fires were class "A" and one class "B."

The total acreage of the 26 fires upon arrival of the first man was .77 of an acre and the final area was 1.1 acres.

The patrolmen apprehended three parties responsible for starting three of the man-caused fires, and three convictions were secured.

The detection-patrol was instrumental in preventing the occurrence of class "B" and possibly some class "C" fires from developing in some of these blind areas, and it proved beyond any doubt that the added detection could be obtained without the expenditure of funds out of proportion to the benefits derived. In fact, the application of both these methods involves no additional expenditure on the average fire forest.

The combination of the "Synchronized Sector Observation Plan for Lookouts" and "Detection-Patrol Plan" used this season, although to a limited degree, was a major factor in producing this year better accomplishment in detection and acreage burned than in any other year of record.

The One-Lick Method—We had occasion to try the one-lick method on the Bob Mt. State fire, November 27. At 11 a. m., 75 men arrived at the fire. A 35-mile-an-hour east wind was accompanied by low humidity. Some little time was taken in looking over the ground and deciding just what to do. Location of a trench to cut off a ¾-mile sector was finally decided upon and 75 men placed on the line with instructions to use the one-lick method. In just 55 minutes after starting, a line was constructed frm which we backfired successfully and held the fire. The line was through an old burn and logged-off area; no logs or snags were cut; speed of construction—72 feet per minute. All men were used on patrol during period of backfiring. More power to the one-lick method in country where it is practicable.—*C. F. Ritter, Superintendent of Construction, Columbia National Forest.*

POSSIBILITIES IN PERISCOPIC DETECTION

I. M. Varner

Administrative Assistant, Boise National Forest

Geo. L. Nichols

Architectural Engineer, Region 4

Experiments such as that described in this article may, in time to come, bring great changes in accepted fire discovery methods. The instrument used in these tests is expensive beyond reason, but no doubt ingenious re-design will reduce this materially. The main point is that for some reason, involved in the science of optics, haze and smoke are penetrated to a degree not achieved by direct vision.

In a study of past fire records evidence points to the fact that regular lookouts with present or existing equipment are not discovering more than about 30 per cent of the fires in Region 4. This is clearly evident from the tabulation that follows.

FIRE DETECTION RECORD
1931 - 1935

	Primary Lookouts	Lookout Firemen	Patrolmen	Other Forest Officers	Total Number Fires
Boise	180	5	51	69	427
Challis	*	*	*	*	*
Idaho	85	68	3	53	303
Payette	116	42	22	62	313
Salmon	25	186	10	34	342
Sawtooth	34	19	23	19	157
Weiser	79	25	24	34	216
Totals	519	345	133	271	1,758

*Figures not available in Regional Office.

In an effort to obtain better detection, especially of small fires soon after they start, a plan has been devised and designed to obtain more systematic action, eliminate factors of uncertainty, and increase the individual and combined effectiveness of the lookouts.

The plan devised included a synchronized Sector Observation Plan. Even with present equipment we are getting valuable improvement in the detection of fires on the Boise National Forest, where the plan has been under trial.

Periscopic Detection was thought of first in a detection experiment conducted on the Boise Forest during 1923 and 1924. In this experiment, heliograph mirrors were used to reflect the impression of a sector from Trinity Lookout. The two mirrors were used in a sort of periscopical arrangement.

It was found that a sector of country could be reflected to a mirror and

that the country could be studied very much in detail without the eyestrain experienced by looking at the country direct. This method permitted an opportunity to study the reflected sector under the best of light conditions. Contrasts under varying light conditions brought out sharper contrasts or definition than could be seen by the naked eye or with field glasses. Tests on fog rising after a rain storm indicated that fog could be detected clearly on the mirror. Smoke could be detected from a class "A" fire four miles from the lookout, the smoke appearing as a sharp image in the second mirror.

It was determined that a reflected image could be secured by protecting the mirrors from direct sun rays of sectors toward the sun during early morning and late evening and the reflected image was much clearer than direct observations. Direct observation with regular means of observation under haze conditions in such sectors during these periods of the day was almost impossible, but the reflections in the mirrors were fairly sharp.

From these early tests the possibilities of improved detection equipment were obvious, as follows:

1. Elimination of eyestrain in detection of smoke.
2. Concentration of observation on a definite sector.
3. Elimination by filters of haze and unfavorable light conditions.

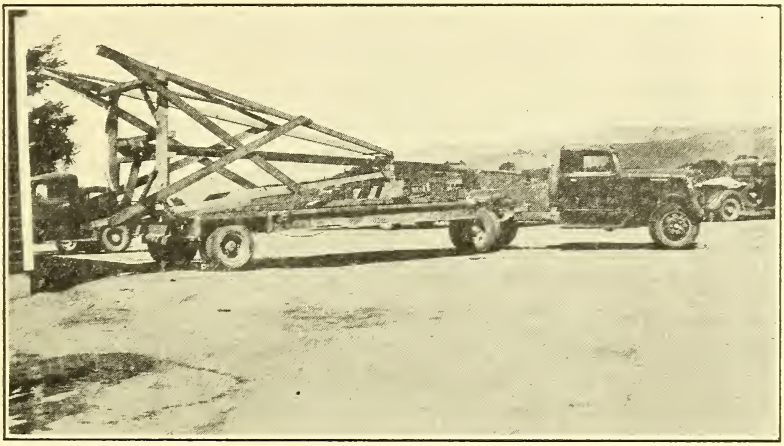
The mirrors of a heliograph, of course, are very cumbersome to handle and offered little except to point the way toward possible improvements in detection. It is our belief that detection has made less advance than any other phase of fire control and that our lookout system has failed to detect fires soon enough after the start; that small smokes, difficult to detect, are not being seen by our lookouts, and some better means for observing these small smokes is very necessary.

The periscope suggested itself as an instrument that might aid in obtaining better detection by concentrating the observer's study to a high degree on a definite sector at a time and allowing a progressive movement of the instrument in scanning one sector after another. The periscope also suggests itself as a means of providing mechanical benefits to aid the human eye.

Continuous efforts were made to secure a loan of a periscope from the Army and Navy, but it was not until August 28, 1936, that a loan was finally perfected, for which we are indebted to Mr. Haynie of the Supply

Depot at Government Island and the Commandant of the U. S. Navy Yard, Mare Island, California.

The periscope arrived in Boise early in September, and, due to its enormous size and weight, a special tower for its use had to be designed and built. Following this the periscope was placed or mounted in the tower and transported from the City of Boise to Shafer Butte (elevation 7591 feet) on the Boise National Forest.



Periscope mounted in tower and loaded on truck for transportation to Shafer Butte for test in fire detection.

EXPERIMENTS AND STUDIES FROM SHAFER BUTTE

On September 22 the periscope had been set up on Shafer Butte and tests were started, using the equipment in fire detection. The periscope was manned by I. M. Varner, Administrative Assistant of the Boise National Forest and originator of the periscopic idea; Geo. L. Nichols, Architectural Engineer of Region 4, responsible for Region 4 fire equipment assignments; J. W. Kimball, regular lookout of Shafer Butte, and Ranger Walter T. Berry, during the tests made September 22 and 23.

The fire tests were directed by Fire Dispatcher Show and Ranger Berry.

Equipment Used in Tests

Tests on Shafer Butte were handled by both the periscope set-up and regular lookout equipment. Shifts were worked so that all equipment was continuously manned during the daylight period.

Specification Data from U. S. Navy Periscope Used:

Submarine Periscope B.U.C. & R. Registry No. 433.

B.U.C. & R. Des. No. 40KA-27
Eye Piece Type A-1

	H.P.	L.P.
Magnifications	6.1	1.5
Field Degrees	8°	32°
Light Transmission		
Exit Pupil—D15	5.1MM	5.1MM
Eye Distance	25MM	25MM
Telemeter	15′	1°
Min. Div.	15′	1°
Center of Field	Elev. 20° / Dep. 10°	

Kollmorgen Optical Corporation, Brooklyn, New York.

Shafer Butte Lookout was also manned. Regular equipment included a 13 Power Navy Telescope and a Marine Binocular.

Bald Mountain Lookout, approximately 17 miles away, was also manned and observing during the tests. It was equipped with Bosch & Lomb 8 Power glasses.

Holly Mountain Lookout—regularly equipped, was also manned.

Shafer Butte Lookout and
Periscope Set-up

Communication Facilities

Shafer Butte periscope set-up included Forest Service portable radio.
Shafer Butte Lookout (Regular)—Telephone.
Bald Mountain Lookout—Telephone.
Holly Mountain Lookout—Telephone.

Idaho City Dispatcher's Office—Telephone and Radio.

Fire Crew—Forest Service Portable Radio.

Communication was possible from each of above at all times with Idaho City Fire Dispatcher.

Plan of Smoke Tests

Briefly, the fire tests were organized so that the lookouts did not know when or where to look for a possible fire (unless specifically noted in notes that follow)—communication made it possible to keep in touch with fire dispatcher and report discovery. The fire dispatcher was in touch with fire crew by radio.

Test No. 1

Test fire No. 1 was three feet across at base. Dry wood and green ponderosa boughs were used for the fire. Fire was set at 9:26 a. m. (9/22/36).

Picked up by Mr. Kimball in Shafer Butte Lookout with Navy telescope at 9:43 a. m.

Watched until 10:32 a. m., when it was put out.

Picked up by Mr. Varner with periscope at 9:43½ a. m. The fire appeared much plainer in the periscope than it did in Navy telescope.

Seventeen and one-half minutes elapsed before fire was picked up.

Holly Mountain Lookout or Bald Mountain Lookout failed to see this test fire.

Fire was located one mile north of Warm Springs Butte on Middle Ridge, 9½ miles from Shafer Butte.

Test No. 2

Test fire No. 2 was three feet across at base. Dry wood and green ponderosa boughs were used for the fire. Fire was set at 11 a. m. (9/22/36).

Neither Shafer Butte Lookout, Shafer Periscope, Holly Mountain Lookout or Bald Mountain Lookout were able to pick up this fire test.

It was on Ophir Creek near bridge, miles from Shafer, and was apparently placed in a blind spot.

Test No. 3

Test fire No. 3 was 30 feet in diameter. A large, dry willow clump was fired. Fire started at 3 p. m. (9/22/36).

No lookout was able to get it. The smoke did not rise high enough or there was not enough fuel in the dry willow clump to make a showing.

The fire was located on Henry Creek, 13 miles from Shafer Lookout.

Test No. 4

Test fire No. 4 was three feet in diameter at the base, and was made by using dry wood and green boughs. Fire was started at 6:17 p. m. (9/22/36).

Fire was picked up with periscope at Shafer Butte at 6:24, or in 7 minutes from time set. Bald Mountain Lookout picked up fire at 6:26, using an 8 power glass, and Shafer Butte Lookout picked it up at 6:27, using a 13 power glass.

The fire was located on Grimes Creek near Pioneersville—17 miles from Shafer Butte.

Test No. 5

Test fire No. 5 was 15 feet in diameter, A large pile of willow brush was burned. Fire was started at 10:16 a. m. (9/23/36).

Looked into drifting smoke, sun and mist for 1½ hours searching for the fire but failed to see it—then we were told where to look, but no smoke rose high enough to be visible. From Shafer Lookout we were forced to look over a hill in our foreground at least 2000 feet high—there was a strong wind blowing to the southeast, and this apparently spread the smoke close to the ground.

None of the lookouts picked this fire up even after they knew where to look.

Fire was located at Dredge on Moores Creek, 9 miles from Shafer Lookout.

Test No. 6

Test fire No. 6 was two and one-half feet in diameter at the base. Dry wood and green ponderosa pine bough were used. This fire was made at the lower edge of the fill on the Centerville-Idaho City Road, which has a white granite background. This was an extremely difficult test, as smoke had to be picked up against a white or smoke-colored background. The small size of the fire added to the difficulty. Fire was started at 2:45 p. m. (9/23/36).

The fire was located at 4:25 p. m. with periscope.

No other lookout could pick it up with the glasses. It was so located that it would have been directly visible to Holly Mountain Lookout and Bald Mountain Lookout, as well as Shafer Lookout.

The fire was 12½ miles from Shafer Lookout.

Following the six test fires used on September 22 and 23, additional tests were carried on, using standard forestry smoke pots or candles, manufactured by the Multnomah Fireworks Company, Aurora, Oregon. These tests continued through and including September 28. Changes were made in personnel manning equipment, and from this point on in the report reference is made to individuals operating equipment or concerned with the test.

Test No. 7

Test No. 7 was a smoke pot or candle set off at 9:30 a. m. (9/26/36), nine miles from Shafer Butte.

J. W. Kimball, manning periscope, picked up smoke at 9:30½ a. m. The lookout did not know where the smoke would be set except that it would be in a 20° sector. Discovery was made looking into sun, moderate smoke haze. Smoke was 9 miles from periscope.

Test No. 8

Test No. 8 was a smoke pot located 14 miles from Shafer Butte. The smoke was started at 2:04 p. m. (9/26/36), and was discovered by Mr. Kimball with periscope at 2:05 p. m. The smoke could not be found with the naked eye. This smoke was 14 miles from the periscope.

Test No. 9

Test No. 9 was located 24 miles from Shafer Butte. Smoke pot was set off at 4:49 p. m. (9/26/36), and five more were added at 5:03 p. m. Mr. Kimball discovered the smoke through the periscope at 5:04 p. m. At 5:14 p. m. another smoke pot was set off, and at 5:14½ p. m. was discovered by Mr. Kimball, using the periscope.

The location was 24½ miles from the periscope. Mr. Kimball knew only the 30° sector in which the smoke might occur.

Test No. 10

Test No. 10 was made September 26, on the top of the ridge, with a small clump of timber for a background to the smoke. A 15-mile northwest wind was blowing, visibility was poor, and Mr. Kimball, at the periscope,

had to look into the sun. Mr. Kimball was given the information by radio that the smoke would be on the west Fall Creek ridge within a certain 7-mile sector.

The first smoke pot was set off at 10:15 a. m., and Mr. Kimball discovered it through the periscope at 10:16 a. m. The smoke was extinguished at 10:20 a. m., and Mr. Kimball told the exact time it disappeared.

At 10:22 a. m. two smoke pots were set off, one at the old position and one at a position 400 feet to the south. Mr. Kimball discovered the one at the old position at 10:23 and the second one at 10:24, and described their positions as less than one-fourth mile apart.

This location was 39 miles from the periscope. These smokes could not be seen by the naked eye or with a 13 Power Naval Glass.

Test No. 11

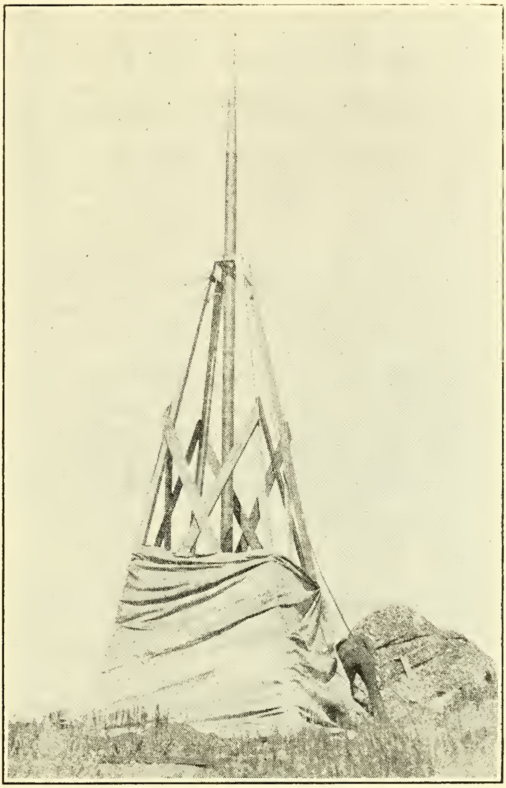
Test No. 11 was made September 28, at a position on the north slope of House Mountain, a distance of 40 miles from the periscope. Lookout L. Balter and Ranger Fest were at Shafer Butte, and Mr. Balter was manning the periscope. They were given the same information as was given in Test No. 10 to Mr. Kimball. There was a 10- to 20-mile northwest wind. The location for the smoke was in fir timber. Visibility was good.

One smoke pot was set off at 1:55 p. m., and was discovered by Mr. Balter at 1:57 p. m. At 2:05 p. m. one smoke pot was set off at the same location and one 500 feet west and a little higher on an open grass hillside. Mr. Balter discovered both of them at 2:05½ p. m., and correctly described their location, and told when they were extinguished.

At 3:05 p. m. another smoke pot was set off in heavy timber a few rods to the east of the position of the other tests, and Mr. Balter discovered the smoke at 3:06 p. m.

These smokes could not be seen by the naked eye, nor could the lookout be sure they could be seen through an 8 Power Binocular.

On September 21, at about 6 p. m., the first evening the periscope was set up, a fire was sighted on the Idaho National Forest east of Long Valley, about 75 miles away. The periscope beat Swanholm Lookout of the Boise National Forest one hour in discovering this fire. Radio reported fire to be one acre in size.



A close-up view of tower and periscope. The canvas enclosure was used on account of extreme cold winds. From size of man, the large size of periscope is apparent.

Conclusions

1. Small fires are hard to pick up unless the glass used is of high power. The periscopic 6 power lens, however, proved more efficient than the 13 Power Naval Spy Glass or the 8 Power Bosch & Lomb Binoculars. The periscope's 1.5 power glass proved of little value.

2. Spy glasses, binoculars, or field glasses are not the most feasible equipment to use in searching for fires in the sector method, until a check is wanted of suspicious spots located with the naked eye.

A spy glass puts an operator or lookout in extreme tension and is hard to hold, and sees only small spots at a time.

The periscope as it is rotated through each sector provides clear vision of country. A complete, accurate check of all country through which it is

rotated is definitely possible. Very little adjustment is needed to operate the periscope to secure clarity for forest fire detection. Greater concentration may be had in any sector viewed.

3. No fires of size tested could be picked up with naked eye.

4. The periscope is very practical in present form, except that it is believed that a cheaper and lighter instrument could be designed and built for our purpose of fire detection.

It is very evident that the height of a periscope above the lookout would be dependent on conditions of elevation at that lookout. It is believed that the increased height of a periscope tube on some points might prove a decided advantage (providing the same advantages of a short tower) and allow more seen area near or around the lookout point.

5. One extreme advantage of the periscope equipment is that it is not obstructed by structural elements of the lookout building in any part of a sector. Clear vision is possible around the entire circumference of a lookout house.

6. The periscope allows such an improvement in seeing detail that old methods at once seem inadequate.

A periscope allows vision of a moving cow six miles away. Details are clear and sharp. At 13 miles a truck moving along a road could be seen. Dead trees in the forest were clearly visible at 14 miles—the trunks appeared well in relief. White painted buildings on a lookout 36 miles away could be plainly seen. Test No. 11 proves that small smokes 40 miles away can be seen under average conditions.

7. The periscope proved that under even adverse conditions, in which visibility was considered poor by experienced lookouts, remarkable results were possible. At the time of the tests (except last day) haze clouds were in all depressed or low areas. Heavy smoke drifted throughout all country viewed, and the horizon was black with a dense smoke blowing in from other fires in adjacent country, yet under these conditions the periscope gave results equal to what would be expected in average visibility conditions.

8. The periscope proved that a power glass or mirror arrangement substantially mounted, with proper operating mechanism, can be operated easily without strain and to a greater degree of efficiency in detecting smoke than present or existing fire detection equipment.

Recommendations and Proposed Specifications

1. It is recommended that the Fire Equipment Committee give due consideration to these findings, and that the Forest Service secure the services of an expert or the cooperation of the Navy in designing the proper periscope for Forest Service detection needs.

Attached is a print from a drawing suggesting the type of equipment and manner of placing which is believed appropriate for our needs. No attempt has been made to technically design the operating lens or mirror mechanism, as it is believed the proper technical experts would save the service money and experimentation in this.

It will be noted that the proposed equipment (refer to prints of drawing attached) includes a complete unit of periscope, sector control disc, fire finder, alidade, etc., for two types of installations—one through side of roof and other through the peak of a lookout house.

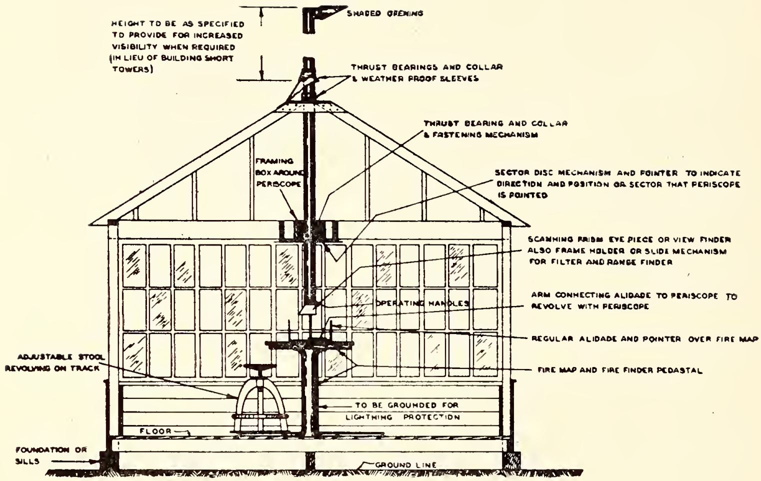
2. It is recommended that the power of the periscope be equal to the one borrowed from the Navy, as mentioned early in this report. The housing and other parts of the periscope can be made lighter in weight—in fact, we believe that sheet copper tubing as a housing will be sufficiently good.

3. In connection with the periscope, it is recommended that a range finder be developed or located on the periscope as an accessory which will give some idea of distance from the lookout to a fire.

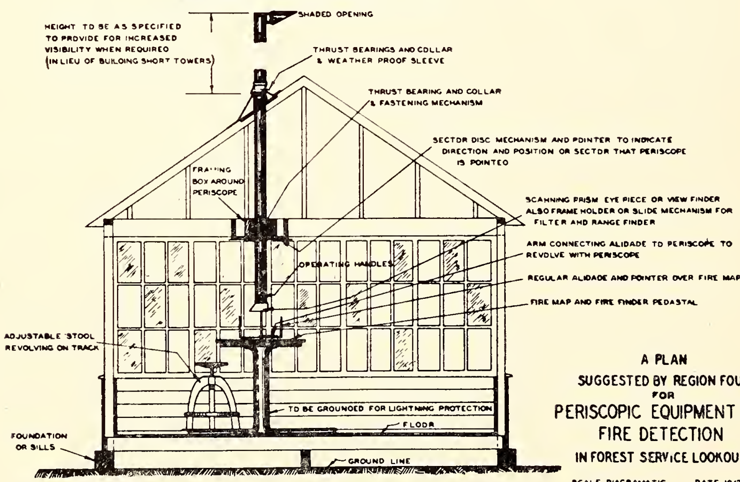
4. It is further recommended that a series of filters for looking to haze, direct sunlight, or smoke be attached in a frame or arranged to revolve in front of the eye piece or view finder.

Our studies and tests developed seven different filters of extreme value.

5. It is our recommendation that in developing the periscope for forest fire detection that the design be held to a minimum in cost, because it is believed that its use and general adoption is going to be dependent on this cost.



SECTION INDICATING INSTALLATION OF PERISCOPE THROUGH PEAK OF ROOF OF LOOKOUT HOUSE



SECTION INDICATING INSTALLATION OF PERISCOPE THROUGH SIDE OF ROOF OF LOOKOUT HOUSE

A PLAN
SUGGESTED BY REGION FOUR
FOR
PERISCOPIC EQUIPMENT FOR FIRE DETECTION
IN FOREST SERVICE LOOKOUTS

SCALE DIAGRAMATIC
DESIGNED BY
VARNER & NICHOLS - R4

DATE: 10/24/36
TRACED BY: H W F

THE FIRE WARDEN SYSTEM IN VIRGINIA

John W. McNair

Forest Supervisor, Jefferson National Forest

This article and the four which follow it record real accomplishment in the build-up of organized local cooperation. They reflect great credit upon the men who, over a period of years, worked with energy and understanding to create a system of prevention and suppression which goes down to community roots. The fact that similar results were had in three widely differing sections of the country fosters the conviction that many other areas are susceptible to such treatment.

There was a time when the warden system of fire control now in use, or fast being adopted on the Eastern National Forests, was quite as visionary and impractical as the steam engine, the aeroplané, the radio, or the automobile. We feel, however, that we have now reached the point where this system is fully as indispensable and just as efficient as any of these present-day devices, although there is still plenty of room for improvements, and they are being made every season. It has been a quarter of a century—or in 1911, to be exact—since work was started on the first boundaries to be acquired in the Southern Appalachians, and in 1913 the first tract, the Alleghany Ore & Iron Company and a few smaller holdings, were placed under administration under the supervision of E. D. Clark, Forest Examiner in Charge.

Mr. Clark, whom I have never seen, was described by Mrs. Helen Gordon, Forest Clerk in his organization, as a man of small stature but of inexhaustible energy. From early morning until far into the night he gave the best of his mind and heart to the business of bringing the gospel of forest conservation to an untutored public.

According to the best information that she was able to obtain, the fire warden idea was really originated by a man who was closely associated with all of the early work of the Forest Service in this section, M. A. Price. Mr. Price was a native, owned a good deal of land in the mountains, and was thoroughly loved by all the mountain people. He had been in the habit of fighting fires to keep them from his own land and in helping other landowners to do the same. It was his idea that such cooperation could be carried a step further, and that by offering compensation these same people could be induced to protect all the forest. Mr. Price was considered by many to be a visionary, but Mr. Clark was quick to grasp the idea and to bend his indefatigable energy in carrying it out.

The original idea was to select in each community a man of outstanding ability and influence, pay him a retaining fee of say $5.00 per annum whether he fought fires or not, and allow him to select his own fire-fighters, who were paid at the rate of 25 cents per hour. This amount was calculated

to get the best in the way of man-power. Wages in the Valley at that time averaged $1.25 per day for a 10-hour day.

This scheme, after a very short trial, was frowned upon by the Comptroller, probably because we were paying men who might or might not perform any work for the Government, and wardens were thereafter advised that the position was an honorary one entirely, except when they were actually engaged in fire-fighting. This, apparently, did not dampen their ardor, since we still have many cases in which men point with great pride to the fact that they are fire wardens. In those days the Forest Service idea of fire prevention and suppression was an entirely new one, particularly in this section. The experience gained in the administration of Western forests had not been applied to the purchased forests. The problem, everybody's problem, was how to secure the cooperation of a community accustomed to burn the woods each year to improve the grazing and to help the huckleberries along.

The first step was to secure men of such standing in their communities that their opinions and stand would have weight with the rank and file. Weeks were spent by Mr. Clark and Mr. Price in visiting and enlisting the aid of these men, and it is a monument to their judgment that several of the men whom they selected are still active wardens.

The wardens selected and their interests aroused, the next step was to secure the means of making their work effective. This meant that there must be some means of communication. Practically none of the wardens owned telephones, and without them a warden crew and the Supervisor's office were almost as far apart as before the organization. As has already been said, the Forest Service was entirely a new proposition, and many people had the idea that the Government had come in to take what it wanted, regardless of everybody's rights. This opinion was particularly strong in the mind of the man then in charge of the Shenandoah Telephone System, and, with the idea that the Government was planning to take his lines away from him without proper remuneration, he refused absolutely to allow the Forest Service to connect up with his lines or run into his switchboards without paying an entirely prohibitive sum. This was the only company having lines where we could use them; there was not sufficient money to equip the forest at once with Forest Service lines, so Mr. Clark did the characteristic thing—set about to elect Mr. Price, his co-worker, president of the telephone company. I have heard it said that Mr. Price was the only man in the whole country who stood a chance in a million of defeating the incumbent. There were weeks of intensive campaigning, when it is said that neither the Supervisor, his wife and family, the clerk, nor the office force slept except in snatches, but when the smoke cleared away Mr. Price had

been elected president of a somewhat defunct telephone company. It is a matter of record that when Mr. Price took over the presidency there was no money in the treasury to pay the operators, and a year later, when he relinquished the post, the company was again on its feet; so he not only did a good turn for the Forest Service, but the company and local subscribers as well.

The point had now been reached where wardens had been selected, crews organized, and telephone connections secured. The next question was how to keep up the interest. Through the good work of the wardens the number of fires was being greatly reduced and some further means of stimulation seemed advisable. The forest at that time consisted of two purchase units—the Potomac to the west, and the Massanutten to the east—separated by the Shenandoah Valley, which bisected the area. A certain amount of competition already existed in the matter of fires, and it was thought well to foster the new cooperative spirit of rivalry to the utmost.

A directory of fire wardens and their crews was prepared for each purchase unit. "Fire-fighters of the Massanutten; Massanutten Pioneers Old and New," consisted of eight pages bound in brilliant blue. "A New Story of the Virginia and West Virginia Borders," in gorgeous red binder, set forth the fire-fighting strength of the Potomac. Mrs. Gordon states that she has been unable to learn definitely whether these books were printed at Government expense or whether they were printed by "private subscription," Mr. Clark being the "private subscriber." She is strongly of the opinion, however, that the latter is true. The printing was done at Woodstock, and not by the Government Printing Office.

As a result of pooled ideas, the age-old scheme of competition was decided upon as a good way to further the interest, and there ensued a great orgy of letter writing to the wardens, of whom there were 34 on the Massanutten and 30 on the Potomac, inviting them to a get-together, or rather a pull-apart, party, a tug-of-war between the Massanutten and the Potomac wardens.

These contests were continued from 1913 through 1916, with the exception of 1915, when no contest was staged, with the Massanutten winning the best two out of three contests; so that the Massanutten is now the proud possessor of the shield which was prepared in the regulation Forest Service form and was to become the property of the side winning it four times.

Early in 1917 the Massanutten and Potomac units were merged, the entire area being known as the Shenandoah National Forest. Mr. Clark

shortly left the Service to buy bark for the Houck Tanning Company, and S. H. Marsh succeeded him as Forest Supervisor.

During the 20 years that have intervened since the organization of the Shenandoah National Forest, the warden system has continued not only to thrive on the Shenandoah National Forest, but was early extended to the neighboring Natural Bridge Forest, and is now being organized on the new Jefferson National Forest. The State of Virginia also makes use of a forest fire warden system quite similar to the system in effect on the National Forests. The State Warden System was authorized in 1919 by Section 542 and amended by Act of 1920, Chapter 416 of the Virginia Code. The Forest Warden System, with but few minor changes from its original setup, has continued to grow and develop with experience and training, until now it rightly deserves the reputation of a very efficient fire control organization.

The *esprit de corps* of the organization is maintained at present by warden meetings held once each year, when fire control problems are studied and object lessons, slide lectures, and good food combine to take the place of the old tug-of-war. There are now approximately 250 forest fire wardens on the National Forests in Virginia who form the backbone of our fire control organization for this area. The number of wardens will continue to increase as additional forest land is acquired. It is significant that within the 1,517,000 acres within the protection boundaries of these National Forests the only regular guard positions are a portion of the primary lookouts.

With the advent of the Emergency Conservation Work in 1933 a large number of men were assigned for work on the National Forests, and our warden organization was more or less pushed into the background. For one year at least no warden meeting was held. There has never been, however, the slightest inclination to allow our warden organization to disintegrate, and the work of maintaining the organization in its high state of efficiency is being given special attention this year. Warden meetings are being held, a special effort is being made to get as many wardens as possible on going fires, and the usual contact work is being continued.

A description of the organization and system is briefly as follows:

1. The National Forest is divided into warden districts usually of from 10,000 to 15,000 acres, such districts ordinarily comprising an individual watershed.

2. The best available man who is willing to serve is selected as a warden. He should possess leadership, not only in fire control work, but

in his community, and should be active enough to assume leadership and responsibility in suppressing any forest fire.

3. The man selected for warden, in conference with the local forest officer, then selects his assistants and enrolls a crew of from 6 to 12 men. In several instances particularly well qualified and outstanding men have been designated as chief wardens, who are responsible for three or more local warden crews. Such men act as sector bosses on larger fires.

4. After the warden and crew have been selected they are supplied with fire-fighting tools, placed usually at the warden's home or at the location of transportation for the crew.

5. Each crew must make arrangements for suitable transportation in the event of fire.

6. Every effort is made to tie in to our forest telephone system each warden and as many members of his crew as possible, so as to facilitate not only the dispatch of crews to fires, but the reporting of fires.

7. A Forest Warden Organization Directory is prepared which shows the name of the warden, assistant warden, means of communication, means of transportation, and strength of the crew.

8. Each warden is furnished with an identification card and badge, as well as written instructions.

9. Each warden has full authority, and it is his responsibility to attack immediately any fire occurring in his district and suppress it as quickly as possible. He is also subject to call if and when needed in any neighboring warden district. The selection of men to serve as wardens is of paramount importance. I feel that the job that requires real skill and leadership on the part of the local Forest officers is the maintenance of the *esprit de corps* of the organization and the training of the wardens and their crews, so that they will function effectively on fire prevention, a limited amount of presuppression, and suppression work. Our wardens represent some of our most effective key-men, and as such are in a position to function most effectively in fire prevention work. In all of my own contacts with our warden organizations I have made it a point to emphasize prevention work. It is true that our wardens receive no compensation for such work, being paid only when they are on actual suppression, but these men are, without exception, I believe, extremely public spirited citizens who are vitally interested in protecting the forests of our nation, and are therefore perfectly willing to give a certain amount of their time for this purpose.

I feel that the fire record of the George Washington is very good proof

of the effectiveness of the warden system on fire control and the occurrence of fires. There is little doubt in my mind that the type of people with whom we have to deal has a very marked effect upon the results that we will be able to secure from the organization of a warden system on any forest. We are fortunate in the Valley of Virginia in having a very high type of people who, through 25 years of National Forest administration, have come to see the benefits to be derived from the protection of our forests.

On the other hand, I have in mind a settlement on the Pedlar District of the forest, where in the early days a lot of trouble was experienced from fire. This trouble has now practically been eliminated by the selection of a member of the settlement as Forest Fire Warden. Working through him the standard of living of these people has been raised, and they are now ardent in their protection of the National Forest.

This is an indication to me that, by proper methods of approach, we can convert communities through training and exercise of the right kind of leadership and develop efficient wardens and crews from any of our forest population. At the same time I feel that we can render a valuable social service by more quickly and effectively raising the standards of living in this section.

Two Schemes for Luminous Sights—A considerable number of the fires in the Ozarks are started in the early part of the night, and it is the policy of the Forest to man the lookout towers during darkness hours on the Clark during the spring fire season. Since the more distant fires are generally merely a gleam or "glow" on the horizon, no artificial light can be employed in the use of the firefinder, since it would tend to blot out the glow of the fire. To overcome this the following method has been found effective:

Mount the cylindrical type of luminous light cord locator on the sighting upright on the Osborne Firefinder. The glow of the locater takes the place of the hair in the sighting bar and permits of a fairly accurate reading on the fire.—*Edward M. Howell, Principal Forest Ranger Clark National Forest.*

THE PER DIEM GUARD SYSTEM ON THE SANTA FE

F. E. Andrews

Forest Supervisor, Santa Fe National Forest

So far as I can recall the per diem guard system on the Santa Fe has always been with us. It was born of necessity. In the early days there was no telephone communication, travel was by horse or buckboard, and there were no improvement crews. Lookouts had not been invented. But to a small degree within the forest boundaries, and to a very large extent in the valleys and plains just outside, were groups of long-established settlers in admirable locations to detect fires and to reach those fires quickly, measured by that day's standards. The ranger rode, and perforce sought shelter at night for man and beast. Naturally he sought the best in a material way, and the best available companionship and understanding, and a cooperative spirit in his host. These qualities would generally be most evident in the more substantial and respected men of the respective groups.

As time passed funds became available for tools and tool boxes, telephone lines, lookout stations, trails, and eventually roads and other improvements. These early cooperators were among the first crew foremen, and laborers were selected with the help of their recommendations. The first tool boxes and telephones were often placed at their ranches; so it is without much conscious effort we have in many communities a well-knit force of leaders and laborers available on call or who will act upon their own initiative in case of fires. There was a direct common interest, even if they were not first interested in fires in the abstract. In only a few instances have we believed that fires were set or mishandled for the wage incentive.

Of course the system does not work automatically. Men fail. They sometimes take too much authority and responsibility, or not enough. The judgment used is not always satisfactory and has naturally a relation to the aptitude, experience, and training of the guard. A valuable educational effect is secured. The training and general fire consciousness permeates the settlement. We do not have to recruit our fire and other labor from town or transient sources.

Fire hazards on the Santa Fe are not in the upper brackets. We have plenty of cover, but our fires seldom crown. Our recognized fire season, May 10 to July 10, is frequently broken up by non-hazard periods, but in almost any month in the year we can drop for several days into valleys of very low humidity for a few days at a time, and threats of serious out-of-season fires have occurred. The strategic value of the per diem guard system under such situations is great.

We are using 97 per diem guards this year (1936). In 1934, the last year the records were analyzed from this standpoint, we had a total of 94 fires.

> "First discovery in 18 cases was made by P. D. Gs. Report received and men dispatched in 6 cases by P. D. Gs. Either discovered fire and took charge or received report and took complete suppression action in 27 cases."

This can be seen as extremely important supplementary action to that of our regular protective force, CCC camps, other improvement crews, and the rangers.

In selection and placement of guards consideration is given particularly to blind and sparsely occupied territory without communication facilities, as in such areas our organization is weakest. Nevertheless, in well-developed localities the force has proved its worth time and time again. Each guard is given a definite area of responsibility. Occasionally some jealousy and friction have developed in spite of this, because of some crew muscling in on the other fellow's job, and such cases result in added costs, due to overmanning.

Most of our per diem guards and their following are Spanish-Americans. No special requirements are necessary to secure cooperation up to the extent of their ability. In fact, they stay more closely on their farms and are more ready and willing to drop anything and go now than the Anglos, so as a whole they are more readily available and more willing to see the job to a finish. Elaborate food, bedding, and camp arrangements do not have to be provided, and they have their immediate transportation by horse close by. These are very important items in the initial stages of a fire.

A per diem guard system, like any other system, does not function automatically, but requires careful thought and planning in the selection and subsequent handling. The experience of Region 3 has shown, however, that efforts along this line are effective and well worth while. Its advantages are many, the costs are small, limited to the actual time spent on fire suppression, and if the men are carefully selected only occasionally will expenses become excessive due to over-zealousness in the prosecution of their tasks. These occasional excesses are more than made up by the fine cooperation received throughout the fire season and the feeling of security that many otherwise blind areas are thus covered.

Neither is the value of the per diem guard confined to actual suppression. Since these men are usually leaders in their communities and are looked up to, their influence in reducing man-caused fires is very effective.

THE COLVILLE'S COOPERATIVE FORCE

SUPERVISOR'S STAFF
Colville National Forest

The Colville National Forest lies next to the Canadian line in an out-of-the-way corner of northeastern Washington, 150 miles from Spokane.

Forest cover consists chiefly of fir-larch, lodgepole, and ponderosa pine. Idaho white pine is found only in the extreme eastern portion of the forest, but climatic conditions are very similar to those in the white pine area, with an average rainfall of 14 inches, fuel moisture content at 8 per cent, and relative humidity less than 10 per cent for weeks on end each summer. The forest is broken into a number of small units by strips of farm and pasture land in the valley bottoms. Much of this privately owned pasture is clothed with cheat and wheat grass that becomes powder dry early in the summer. Fires frequently originate on these grass-clothed areas and spread with great rapidity to the wooded slopes above.

Lightning storms are frequent, and occasionally are accompanied by little or no moisture. A single storm has set as many as 50 fires on the Colville in the space of a very few hours. To meet the peak lightning load we have for many years trained a number of local stockmen and loggers to act as emergency lookouts and firemen. These men have been trained individually by the rangers and at mass meetings called in connection with the spring training camps held each June for the instruction of our regular protective force. These trained cooperators have pretty well taken care of our extra man-power needs during lightning storm peak loads and of our extra needs for overhead on all suppression crews in an average year.

Our chief hazard, however, is not from lightning storms, but from man-caused fires that start at lower elevations between 10 a. m. and 2 p. m. of a bad fire day. If these cannot be reached by an adequate force within minutes they spread with amazing speed and sometimes reach large proportions before evening, and require the services of several hundred men to control before the beginning of the next burning period.

With several such fires burning at one time in 1929, and again in 1934, we were forced to employ hundreds of laborers from Spokane and other distant towns, and discovered that the volume of effective work accomplished by such forces was materially cut down because of the lack of sufficient trained foremen and strawbosses. In order to meet the emergency that may occur any summer we must have trained overhead to supervise the work of 1200 fire fighters. To meet this need, during the winter of 1934-35 we recruited 200 men from our 300-odd permittees who agreed to act in the various overhead positions needed. These men are so organized that 1200 green fire fighters can be turned over to them and in a few

minutes be transformed into an effective fire-fighting machine.

Each ranger, through his short-term force or a keyman in each community, keeps in constant touch with this cooperative force and makes current substitutions necessary to keep them at constant full strength. We had no opportunity to give these men a major test in 1935, but with so many involved we thought it desirable to provide for special training and encouragement, so during the past winter and spring we arranged 11 community meetings, to which these men turned out almost 100 per cent. We furnished a hot meal, and the cooperators donated their time and arranged their own transportation to the meeting place. A full day's training in their respective jobs was given at each meeting by district rangers and staff men. Since a majority of those trained had a good deal of experience in fire fighting, the conference method of teaching was used and the points brought out included everything in our training lists, and many others. A record was kept of all points discussed and a mimeographed copy sent to each cooperator for further study. Cooperators who attended the meetings unanimously agreed that systematic advance organization and training of overhead was not only desirable, but essential to successful handling of the fire situation. In order to renew his interest, at the beginning of the hazardous period, the district rangers wrote a "pep" letter to each cooperator.

During the 1936 fire season we were fortunate enough not to have to call for outside fire fighters, so our organization still awaits the supreme test; but initial action was taken by these cooperators on 25 fires. Each of these fires was checked by a ranger or regular fireman, and in every instance it was reported that the cooperator's action was satisfactory. We are convinced that our cooperative organization is conducive to more effective prevention, as well as suppression of large fires. Most of these men have a selfish interest in protecting the forest from fire because of the possible loss of their pasture, timber, livestock, and even their buildings, if fires are not controlled.

There are minor disadvantages in this cooperative plan. With CCC enrollees available to meet the average season's needs, it is difficult to give cooperators sufficient work to hold their interest. Furthermore, it requires a rather startling amount of time on the part of the ranger and his short-term force to keep the organization up to date. But these disadvantages are greatly outweighed by the tremendous advantage of having available on very short notice a trained organization of men who know just what is expected of them, who know the forest, have a vital interest in its protection, and who will prevent any attempt at incendiarism by the suppression force in order to lengthen the period of employment.

We predict that when the next fire emergency visits the Colville these cooperators will give a good account of themselves.

FIRE COOPERATION IN REGION 2—THE BEGINNING

John McLaren

Liason Officer, Sixth Corps Area

For many years prior to the creation of the National Forests in Colorado, I lived in Pitkin County in wooded areas which later became part of the Holy Cross National Forest. In the fall during those years one could see smoke from unattended fires at almost any point of the compass, and naturally Colorado suffered enormous timber losses, for conditions in my locality were not materially different than in other sections of the State, as I afterward learned.

The Holy Cross and other Colorado Forests were placed under administration in 1905 and 1906, and an extremely limited field force was kept busy long hours each day trying to keep up with marking and scaling timber, and fire control was about the only interruption tolerated. From the beginning, however, all forest officers were impressed with the fact that they must be on the alert to prevent fire damage, and necessarily must act promptly if fires were to be suppressed.

Foresters coming into the service today can have no conception of the situation faced in those early years, for there was an almost universal antagonism from every quarter toward forest administration, and some of it was very bitter. Timber operators and grazing men were sure their individual rights were being jeopardized, and others were "agin" it because it was something new and they were not sure it would be of benefit, so preferred to let the old order ride.

This drab outlook faced a ranger when he found it necessary to tackle a fire. Perforce he must get as many men as possible as fire fighters from any and all walks of life, and "please each man bring his own ax or shovel," for those days preceded the era of fire tool caches, telephone lines, automobiles, truck trails, and lookout systems.

Most of the old timers in field service in those days have been replaced by men with more education and nimbler typewriter fingers, but my hat is off to that advance guard that had the hardihood to stick with and worry at the job in the face of the discouraging outlook; and boys, did that bunch do an honest-to-God P.R. job. though the term did not come into usage until some years later. Strangely enough, doggedness and perseverance in fire work seemed to be the opening wedge in getting public confidence, and after a while there was a sort of grudging admission that it did really seem possible to check and whip a fire with man-power, and the efforts of the field men began to bring some praise.

Thus it became apparent that fire publicity was the best means at hand to arouse public interest in the Service and its aims and policies. Fire suppression jobs were publicized in the newspapers, and particular effort was made to give credit to civilians who took part in the work either of detection or suppression. Stress was laid on the need for eliminating fire from the ranges in the interest of stockmen; on the fact that timber must be free of fire in the interest of loggers and lumbermen, and that success in the mining industry depended a great deal upon the elimination of fire. Furthermore, if returns to the counties from the 25 per cent fund were to be worth while and maintained, the resources must be kept free of fire damage. Naturally, individual selfish interests were played upon: Farmers might be bankrupt through the loss of their improvements and the reduced fertility of the soil; a mining operation might be stopped by fire through loss of surface buildings and the necessary timber; and, too, many towns and settlements might be wiped out, with loss of life.

I have been asked how our system of fire cooperation got started. The foregoing indicates something of the way in which the start was made. As to when and where it started, I cannot say. In all probability field men were doing the same thing simultaneously on all forests. Apparently the first universal step was to interest people in detection work. "Keep a sharp lookout for fires and make prompt report to the nearest forest office." As I recall, my first personal attempt along this line was to line up teamsters hauling lumber and logs into Norrie to report railroad fires.

Logging operations were confined largely to the mountainous slopes south of the Frying Pan River, while the Colorado Midland Railroad wound a tortuous route along the mountain slopes north of the river. Only a few miles of right-of-way could be sighted from the ranger station, but the teamsters had a panoramic view of the entire railroad, so they could and did watch for fires and report them. Among those lined up to scan large areas under their immediate control were a resort owner, a mine superintendent, and a German farmer. The latter was a valuable find, for he was German born, had a very intimate knowledge of German forests and forestry practices, and was inordinately proud of having a connection, even without pay, with the U. S. Forest Service in the capacity of a fire guard. He was so enthusiastic and so willing that in a very short time fire tools were placed in his barn, and he was given authority to take direct charge of any fire in his territory and to employ fire fighters as needed.

Even after a few lookouts were manned, the public was requested to see how many times they could beat the lookout observer in reporting fires, and they gleefully responded. This voluntary service was extended year after year until there was a very large number of individuals who could be

depended upon for detection and a smaller number who were entrusted to take initial action and incur expense in fire suppression. Let me repeat that this was not the only territory where progress was being made. No doubt much was accomplished in other regions, but there was a lack of general knowledge among the field men of the various forests as to how results were obtained, and such information as was obtained came largely from inspectors of the Regional Office at infrequent intervals and at rangers and supervisors' meetings.

When the Regional Office established the position of Fire Chief, a survey disclosed that while excellent progress had been made in rousing the public to be fire-minded and co-operative, it was very spotted even as to individual forests: There was a lack of standardization in fire tools both as to kind and number, and the majority of the fire plans were of the old narrative type—too voluminous and bulky to be of much value even to the men who made them. Fire tools were standardized rapidly, and Region One's Fire Organization Chart was adopted in modified form.

Effort was immediately centered on convincing each and every field man of the importance of enlisting dependable public co-operation. This, by the way, was not accomplished in a season. Eventually it did exist well toward 100 per cent as a mass consciousness from the newest member of the force, through the Supervisor's office to the Regional office, to the Regional Forester himself. There was an essential objective, for mass effort produces mass results. The chart referred to became the fire plan for each ranger district, and responsible citizens at strategic points were listed as keymen. These were men who were, and are, called on to drop their private work and devote time and energy to public interests. These plans were frequently inspected and checked in the field to insure that they were not paper plans only.

The methods employed were many and varied, and depended upon the initiative of individual forest officers and the individuals to be worked on. In general terms: "We are a skeleton force willing and anxious to do everything possible to protect the resources, but you are the owners of these forests—the stockholders in this concern—and without your whole-hearted interest and action we must fall short of the success otherwise possible."

Each forest officer must believe whole-heartedly in the worth of converting apathetic or indifferent individuals and communities to an active sense of duty in fire control—it can be done. The forest ranger has better chance for success than others, for he personally knows the people in his territory, has a knowledge of their personal interests and their idiosyn-

crasies, and therefore has the best approach.

The system works, and where maximum effort is put forth you will find fewer fires and less damage than formerly. In certain localities more than half of the fires in a season are extinguished before a forest officer knows of their occurrence.

For any section where there are settlers or other inhabitants, I will take co-operators. The citizen who takes pride in a record for his territory is more dependable and will get better results than the average run of salaried guards.

Mechanized Line Construction—Recognizing geographic opportunities for the use of machines for fire line construction, and quickly taking advantage of them, Columbia National Forest personnel gave an effective and practical demonstration in the use of tractors on fire line construction by stopping at the forest boundary the advance of a State fire which originated within the Pacific Logging Company slash near Underwood, Wash.

On October 13 this fire had reached proportions endangering Forest lands. In anticipation of the fire's further spread, a "60" Cruiser type "CAT" and a "50" "CAT" with trailbuilder were dispatched to the scene, where the cruiser "60" went into action breaking trail and moving the heaviest of the logs and debris, followed by the "50" trailbuilder, opening the fire line to mineral soil. The terrain was rolling to steep, covered for the most part with heavy brush and reproduction, and many down logs. The equipment as used reduced to the minimum the necessity of hand bucking and slashing.

An idea can be gained of the efficiency of the "50" "CAT" with dozer attachment working alone as shown by results: 8200 feet of 6- to 10-foot fire line was constructed in 13 hours' operating time, approximately 630 feet of line per hour, with an average width of 8 feet. Immediate back firing was undertaken along the various sections of line as the fire approached, and, needless to say, no fire reached the forest or crossed the "CAT" trail. In addition to this, a large log was extensively used in connection with the "60" "CAT" by dragging it behind to construct a fire line down to mineral soil. Several miles of this type line were constructed, generally on types of country where the "50" and dozer could not be operated. This system works extremely well, and is one of the fastest fire trail builders that I know of. The "60" "CAT" knocks down the brush, which is removed by the log, and at the same time removes duff and other debris, leaving a fire line not only down to but below mineral soil. Generally we found it necessary for a squad of men to follow the machine and clean up sections that were missed by the logs on account of deep gullies or sharp ridges. Line was constructed by this method at an average rate of 1 mile per hour.

In one particular instance the "60" and crew were skirting a fast fire when the "CAT" got into trouble and it became necessary to concentrate the crew to construct a line around the machine and backfire in all directions. This worked, and after the rush was over line building was continued, but the moral is, have a "drum" or power winch attached to the tractor to facilitate getting out of "tight or cramped" positions in the least possible time under emergency conditions.—*C. F. Ritter, Fire Assistant, Columbia National Forest.*

FIRE COOPERATION IN REGION 2—THE TASK OF MAINTENANCE

C. J. Stahl

Associate Regional Forester, Region 2

The cooperative fire control organization conceived and put into practice by John McLaren, Region 2, is, as the name implies, a cooperative undertaking. The public's interest in the organization depends very largely upon the interest which the organization engaged to do the job of National Forest protection displays, and to a very large extent on the effectiveness of that organization's efforts. It is something which will not continue on momentum. It is an uphill route all of the way, and when the current is turned off the machinery stops. Whenever it slows down it is harder to get it at full speed ahead again than it was in the first place.

The cooperative organization is beset with discouragement and interference. It is a delicate thing to bring to a cooperator's attention failure to fully extinguish a fire which was fanned into life after having been left by him. One man does not like to take instructions from his neighbor when more than one of them goes to the same fire. Each likes to have full credit for having discovered and assumed responsibility for extinguishing the fire.

Interest must be kept alive by constant effort on the part of the local Forest officer. Settlers naturally take a greater interest in the territory immediately surrounding them than in the National Forest unit as a whole. It is not hard to convince a man that territory in which his range is located, or where water for his irrigation rises, or building materials are grown, or fuel for his heating plants is supplied, should be of special interest to him. He can even be persuaded to believe that country within view from his home is of far greater value to him if covered with timber than if damaged by fire, so that he, as a result, must gaze upon a denuded slope.

Once a man agrees to act as a cooperator or keyman, he may not be neglected. His interest in the protection of the forest will never become so great that he does not require an occasional stimulant, and it is doubtful if he would be sincerely interested if it were not for his liking for the Forest officer, who is responsible for the territory, and who has presented the subject to him. There must first of all have been established friendly relations between the two, and it is more often a result of the settler's friendship for the officer that influences him in protecting the area than his sense of public duty.

An annual visit to the settler to discuss his continued cooperation is not

sufficient. His friendship must be kept in repair, and the officer must display an interest in the settler's affairs commensurate with the interest which he seeks to develop in the settler for the protection of his resources. In the last three or four years Forest officers have been so driven with additional duties that contact with the settlers has been neglected. Nowhere has this shown up to greater disadvantage than in cooperative fire control.

Another thing which has materially affected the interest of the settler is the use of CCC in fire control. In many cases the cooperators have gone to a fire as usual and then when the difficult task of bringing it under control has been accomplished, the CCC arrives and takes on the responsibility of completely extinguishing the fire. There is a very general feeling among the cooperators that they are no longer required, and the same haste to get to the fire without delay and the same determination to put it out to the last spark is lacking. Where there have been no CCC camps the cooperative scheme still works very well. It still works everywhere, but not as perfectly as formerly.

It is not a scheme which can be made to work by written prescription. Each individual must be handled in the way in which his disposition requires. The approach is always different. Settlers have been known to leave the hayfield and take their men with them. The manager of a dude ranch has been known to cancel a pack trip and handle a fire. On rare occasion a settler has neglected to go to a fire which was reported to him, and dude parties have been known to start fires by failure to put out camp fires when breaking camp and by carelessly smoking along the trail.

To keep the system working requires constant and sustained effort. It will work, and does work, if the field can be kept on its toes; and it is another job to keep the field on its toes. The heavy turnover in the field force is responsible somewhat for a slackening in the interest displayed by cooperators. The machinery, if kept keyed up, is as effective as an organization of salaried guards, and is probably no more difficult to train and keep efficiently functioning than are guards.

A FIRE GUARD TRAINING HANDBOOK IN THE MAKING

J. F. CAMPBELL
Fire Control, Region 6

The number of emphatic remarks at the 1936 Spokane Conference on the importance of training among fire control activities is an indication of the high priority given this subject. The author, who is taking a leading part in the handbook building, presents here an encouraging progress report.

For many years attention has been given to training fire protection men for their jobs. In some instances this training has been good, but more often not so good. Observation and inquiry into what goes wrong in fire suppression gradually brought about a realization that there is a wide gap between the knowledge of what should be done on fires and what is actually done on them. The perfection of protection practice lags far behind knowledge. With this realization has come an appreciation of the fact that, since the success of the protection projects depends so much upon the human element, it is necessary to go the limit in finding and using the best methods of selecting and training the protection force.

During the last few years a great deal of excellent training work has been done in the Forest Service. This has consisted of individual "in-place" training, training camps, conferences, study courses, correspondence courses, and the preparation of a number of handbooks. However, the greatest advance, so far as fire training is concerned, came with the introduction of vocational training methods.

Recognizing that while much had been done, training offered one of the greatest fields for improvement in fire control, Mr. Roy Headley, Chief of Fire Control, arranged for a meeting of fire and training men from Regions 1, 4, 5, 6, 7 and 8. This committee met at Portland, Oregon, December 2 for the purpose of pooling their knowledge and experience in the preparation of a fire guard training handbook which would be suitable for use throughout the Forest Service and also serve the needs of other protection agencies.

The first few sessions of the committee, under the chairmanship of A. H. Hodgson, were devoted to deciding upon the scope of the handbook and outlining its chapters. Sub-committees were then appointed to prepare the subject matter of the chapters. The committees had Forest Service training handbooks, a number of textbooks, and other works on personnel training available for reference. The first rough manuscript prepared by the committees indicates that, while liberal use was made of these references, much

original thinking and the rich experience of the committee members is reflected in their work.

It was decided that the handbook should be prepared primarily for use in fire training, although the principles of training men for fire work are not fundamentally different from training them for other forest jobs. The handbook will contain six chapters. Chapter I will be devoted to an introductory statement and a description of the fire-training project in the Forest Service. Chapter II outlines the types of training, such as group training, training on the job, and training by telephone. Chapter III deals with methods of training, such as the four-step method, conferences, dramatization, and lectures. It also includes sample lesson plans, and suggests a method for making them. Chapter IV proposes a plan for training instructors, or, in other words, training others to train. Chapter V has to do with the subject of "Determination of Training Needs." Starting with a breakdown of the job, it describes a method of appraising or estimating the needs of individuals to be trained, and leads up to the final Chapter VI, which is entitled, "Planning the Training Program," and which describes a method of planning the complete season-long training program for each member of the protection force.

The work of each sub-committee was presented to the committee of the whole for consideration, adjustment, and approval. The rough manuscript was turned over to Ray Lindberg, Personnel Training Assistant in Region 6, for editing. It is expected that the Fire Guard Training Handbook will be printed and available for use by the beginning of the 1937 fire season.

Difficulty is encountered in getting accurate readings on night fires, because of the fact that when a light is made in a lookout tower at night the reflection of the light in the windows interferes with sighting, particularly on a small fire at a distance. To overcome this, the Angeles National Forest has been experimenting during the fire season of 1936 with radium-treated cross hairs on the Osborne Firefinder.

It is necessary to replace the hair with an iron wire of similar size to withstand the action of the radium. This wire is treated with a preparation of radium compound. The cost is nominal, as it is necessary to treat only one inch on each of the intersecting points of the cross hairs or wires. Anyone who has used a luminous dial watch can readily appreciate how this will show up at night. and still not interfere with daylight sighting. This improvement has been used on the Angeles during the past season, and the lookouts and rangers who have used it consider it a real improvement.—*Angeles National Forest.*

TWO WELL-WON TRESPASS CASES

REGION 1

Law enforcement, whether directed toward a large corporation or an individual, is an instrument of fire prevention whose importance should have greater general recognition. This article records the successful prosecution by Region 1 of two difficult Trespass cases—one against a railroad and the other against a bank. Thorough preparation and vigorous handling brought splendid results. These were both fine jobs. We all have much to learn from these examples of aggressive spirit and detailed preparation.

RAILROAD CASE

Region 1 scored a substantial victory in the trial of the fire trespass case against the Milwaukee Railroad Company at Coeur d'Alene, Idaho, when a jury in the United States District Court for Idaho, on December 9, 1936, brought in a verdict for the Government of $25,911.40 for fire damage to brush, young tree growth, and other forest cover, in the St. Joe Forest, and $49,859.65 for fire suppression costs. The jury, mostly farmers, awarded the Government the entire sum asked for fire damage to forest cover. This case shows recognition of the value of brush, small trees, and other forest cover in the National Forests, in the minds of that jury.

The case arose from the Avery Fire of 1934, which, the Government contended, started on the railroad right-of-way near Avery, Idaho, and which for a time threatened the town of Avery. The case is distinguished from preceding fire trespass cases. The Government based its suit solely on the railroad's failure to keep the right-of-way clear of all inflammable and combustible material, as required by the stipulations filed in connection with the grant of the right-of-way through the St. Joe Forest, and by the law of the State of Idaho. The Government's contention that the fire started close to the north rail of the track in the right-of-way, spread to Northern Pacific land and then to Forest Service land, was disputed by the railroad company. The company claimed the flames started a short distance outside of the right-of-way and spread down-slope onto the defendant's lands. Twelve witnesses were put on the stand to uphold this point.

The Forest Service, however, qualified four witnesses as experts in fire behavior, and specifically as to the origin of fires. These stated that, because of the slope and the wind prevailing at the time, the fire spread upslope, and that it had started on the right-of-way. The jury placed greater weight upon the testimony of men long experienced in the ways of forest fires than it did in that of the railroad's less impressive witnesses. Most of the railroad's witnesses were recruited from the Civilian Conservation Corps enrollees who were sent to the fire for duty thereon.

One of the great difficulties in handling the case came in proving expenditures made in the suppression of the fire. The court refused to accept the fiscal papers of the Government showing the expenditures made at the fire. It was necessary to produce the Forest Supervisor who had actual charge of fighting the fire to prove that he had personal knowledge that the expenditures actually were made as shown by the papers. The court held that proof of payment of items was not necessarily proof that the work for which claim was made was actually done on the fire. The case, attorneys said, exemplifies the need for close observation by the first Forest Service employees who arrive at a fire. Some of the witnesses for the Government were not entirely sure as to some details which became important in the case. The need for keeping in close touch with fire expenditures so as to be in a position to prove that money was spent for fire suppression also is stressed, along with the need for having simple, understandable statements of fire expenditures.

The judge indicated in his charge to the jury that he would award to the Northern Pacific a proportionate share of the judgment for fire suppression costs. The Northern Pacific had intervened in the suit, without objection from either the plaintiff or the defendant. This company, whose lands are protected by the Forest Service under cooperative agreement, had already paid to the Government a sum of money representing its proportionate share of the costs of suppression.

The Bank Case

On December 16, 1936, the Solicitor of the Department of Agriculture, referring to the opinion and judgment of the U. S. District Court for Montana in the case of the United States vs. The First State Bank of Thompson Falls, wrote as follows to the Attorney General of the United States:

"Aside from the amount of money recovered—$1,163.28, together with interest in the sum of $338.66 and costs of the suit—the decision of the court upholding the constitutionality of the State statute under which the suit was brought is of great value to the Forest Service in carrying out its fire protective program.

"The suit was brought under a State statute for the costs incurred in the suppression of a forest fire originating on land owned by the bank. The statute declares that an uncontrolled or spreading fire in forest material from May 1 to September 30 is a public nuisance which may be summarily abated by the State or the Forest Service of this Department or any forest protective association recognized by the State Forester. The owner is made responsible for the cost of suppression which, unless paid within thirty days from date of demand, may be recovered in an action of debt by the State or the United States or the association which abated the nuisance.

"It will be recalled that when the matter was first brought to his attention the United States Attorney questioned the constitutionality of the statute, citing a number of cases in support of his belief and stating that in a similar suit a State court had sustained a demurrer to the complaint upon the view that the statute was unconstitutional. He subsequently filed the suit and won the case. The bank employed able counsel to argue the constitutionality of the act.

"Statutes similar to the Montana statute are in force in other States. The decision in this case will, therefore, be helpful in the event it is necessary for the Government to file suits under those statutes.

"In the circumstances, the Department would be glad to have you express to the United States Attorney its appreciation in this behalf."—*Mastin G. White, Solicitor.*

The decision is of such importance generally that the pertinent portion of it is quoted herewith:

"The fire, so it is agreed, was discovered about 3 p. m. on the land, hereinafter described, by James Goff, who with his mother, went immediately and tried to extinguish it, but were unable to do so; later the father joined them but with no better success. The fire started in an old chicken house on the SE¼ of SE¼, of Section 24, being the land in question, and 'from a cause or source unknown to and for which it is not claimed that the defendant was in any way responsible save as herein specified.' The fire was finally put out by Supervisor A. N. Abbott and his men on September 7, 1931, at an expense of $1163.28. The parties agreed that: 'The defendant was never at any time in actual physical possession of the property or any part thereof and never at any time made any effort to cultivate or operate the same or to rent or sell the same to any person or persons whatsoever.' The defendant knew nothing of the existence of the fire on August 28th, but knew about it in the forenoon of August 29th. This was long after the supervisor and his men—34 in number—had taken charge.

"The statutory provision relating to fire and applicable here is Section 2, Chapter 95, Laws of Montana 1927, also Revised Codes of Montana, supplement, Section 2776.2, which reads as follows: 'Uncontrolled fires nuisances—Liability—Abatement. Any uncontrolled or spreading fire in forest material in the State of Montana, from May 1 to September 30, inclusive, is hereby declared a public nuisance. The person, firm, or corporation on whose property such fire exists or from whose property such fire spreads, is hereby made responsible, to the extent hereinafter set forth for its control and extinguishment. If the person, firm or corporation thus responsible, shall refuse, or neglect, or fail to take reasonable steps to control or extinguish it, the State Forester, the United States or any organized and functioning forest protective association recognized by the State Forester, may summarily abate such nuisance by controlling or extinguishing the fire, and the cost thereof may be recovered from such person, firm or corporation responsible for such fire by the State of Montana, or the United States, or the association, which extinguished or controlled it. If the person, firm or corporation shall fail to pay in full the total amount due within

thirty (30) days after date of written demand for payment, such amount may be collected in an action for debt by the State, the United States, or the association which abated the nuisance.

"Provided, that when any person, firm or corporation has listed his lands with any such regularly organized and functioning forest protective association recognized by the State Forester, or with the State Forester or the United States Forest Service, it shall be considered that he has taken reasonable steps to control and extinguish fires as described in this section except such fires as may be the result of his negligent act, conduct or operations.

"The principal questions here are, was defendant the absolute owner of the land, and if so, did he fail to take reasonable steps to control or extinguish the fire. Defendant held the legal title and transferred the property under contract. So far as the agreed statement and the record disclose defendant was the owner. It claims to have retained a note, but that does not seem to have any particular significance in view of the other circumstances. Did defendant fail to exercise reasonable care? He did not list the land as provided in the statute. On hearing of the fire defendant might have sent a representative to cooperate with the men who were fighting the fire from September 27th to October 9th. But, as it appears, no effort was made to help the fire fighters. This was not only not taking reasonable steps to control or extinguish the fire, it was not exercising any care or taking any steps whatsoever to control or extinguish it. To be sure, defendant did not learn of the fire until the following forenoon but it was still burning and spreading and continued to burn until October 9th, thereby affording defendant ample time to manifest some interest in this devastating fire that had its origin on property of which it was the owner.

"If the statute is not applicable to the state of facts found here it would be difficult to find a case following within its provisions. It seems to the court that there is sufficient evidence to warrant the finding that the deed was in fact a deed absolute and not a mortgage, and it is so determined, and that under the evidence and a plain reading of the statute that the defendant failed in the performance of the duty thereby imposed, and is therefore liable for the cost sought to be recovered in the foregoing action, and judgment will be entered accordingly. The court has considered the arguments of counsel as to the validity of the act in question and is of the opinion that it meets constitutional requirements and is therefore valid."—*Charles N. Pray, Judge, United States District Court of Montana.*

Use of Firemen's Masks—During the past summer fire season intense heat (both atmospheric and that from fires) was encountered, as well as suffocating smoke because of the large amount of green material being burned. Several men used goggles to protect their eyes from smoke, with some success, and it is contemplated trying out masks for this purpose (probably a regular fireman's mask). These firemen's masks, or others of similar type, should protect not only the fire fighter's eyes but his face and lungs as well. We should like to know of any experience anyone has had along this line.—*Edward M. Howell, Forest Ranger, Clark National Forest.*

REFLECTIONS OF AN "INSPECTED"‡

(On a Busy Fire Forest)

NUMBER OF WORK DAYS IN YEAR

Total days in the year	365
Minus Sundays	52
	313
Minus holidays (legal)	7
	306
Minus annual leave	26
Remainder	280
Plus Sundays I don't get	52
	332
Plus holidays I don't get*	4
	336
Plus annual leave I don't get	25 3/7
Net work days in year	361 3/7

*Exclude New Year's Day, Washington's Birthday and Christmas.

Why don't I get these days for rest, recuperation, meditation, etc.? To be specific, there are some 50 very active activities on a National Forest, each of which is broken down to details that run to 00 (infinity to you—not goose eggs), many of which have from one to six functionaries going under the general classification of "Inspector," to each of whom I am expected to devote some time, varying in amount from a few minutes to a few days every month.

Inspectors can be subdivided into classes almost without limit. A logical subdivision for future reference might be as follows:

Class 1 Inspectors (real)	5% of total
Class 2 Inspectors (vacationist)	10% of total
Class 3 Inspectors (visitors)	15% of total
Class 4 Inspectors (Junketer)	30% of total
Class 5 Inspectors (expert)	40% of total

That wouldn't be half bad if the frequency were completely reversed. It's a pleasure to know that some of them can get a vacation—maybe we'll be an Inspector some day, and we wouldn't want a complete halt called on that sort of thing!

Let's see, what do we need—statement of the problem; method of procedure (plan); put plan in action. (PK will be horrified at anything so simple as that for an outline.) In this case the plan and putting the plan in action may be considered one and the same.

‡Article received as an anonymous contribution.

Plan for Distribution of My Time to Be Devoted to Inspectors (Days Per Month)

CLASS	1ST QUARTER*	2ND QUARTER*	3RD QUARTER*	4TH QUARTER*
1	1.0	2.0	2.0	1.0
2	.005	.000	.000	.01
3	.0005	.005	.005	1.0†
4	.005	.000	.000	.005
5	.000	.000	.000	.000

*Calendar year.
†Practically any amount if talk is of duck hunting.

Test Smokes—This summer the Regional Office sent out orders to use test smokes to check lookouts for alertness in detection, accuracy in location and size of smoke, but mostly for attention to the job.

In using these test smokes several difficulties have been encountered. Because of the fire hazard, a method which would be both safe and practical and at the same time give a fair test to the lookouts had to be devised. It has been a considerable problem to make a smoke that will rise above the tree tops and still be safe. If there isn't enough heat under the smoke it will condense before it rises high enough to be seen.

I tried several different methods this summer, and found that the most satisfactory results were obtained by using a barrel from which the top had been removed, and in the side of which a four-inch hole had been cut about two inches from the bottom. Over this hole I had a tight-fitting door hinged. This was the draft opening. Then I placed a piece of stovepipe, which had been punched with half-inch holes three inches apart, across the bottom of the steel barrel with one end against the draft opening. By opening or closing the door I could control the heat.

It was difficult at first to find fuel that smoked sufficiently and still had heat enough to lift the smoke above the tree tops. I tried used motor oil together with green boughs, but there was so much gas in the oil that it caused the fire to flare up and didn't send out an even volume of smoke.

After experimenting a while, I found that the best results were obtained by using motor oil and a small quantity of dry wood, then placing the green boughs on slowly enough to keep the blaze down and an even supply of smoke rising continuously. Placing a blow torch at the draft opening will increase the volume of smoke.

In order to manage the barrel easily, I fastened a handle on each side of it, about half-way down. Then I cut a lid of heavy tin to fit the top of the barrel. When I got through with one test smoke, I loaded the barrel into the truck and started to another location with the fire all ready to make another test. The bottom of the barrel stays cool, so danger of setting the ground afire is very low, and the barrel is easily transported in a truck without burning the truck bed or scattering sparks. The heavy, tight fitting lid and tightly closed draft make truck transportation a safe and quick method of carrying the barrel from one test to the next.—*R. C. Paullin, Ranger, Cabinet National Forest.*

FOREST FIRES IN EUROPE

C. E. Rachord

Assistant Chief, Forest Service, Washington

What a contrast there is between man-caused fires in America and in Europe! Here, wild land continues to be abused by the same deep-rooted carelessness with fire which has largely converted our heritage of forested land into wreckage; there man-caused fires are almost unknown. How did they get that way, and how can we promote the formation of habits such as the author found in European countries? We do not enjoy the favorable climate and close utilization of those countries. We are compelled to try to make up for those deficiencies by introducing the human habits so common in Europe, where they are less necessary than here.

Sixty-two and one-half hectares (156 acres) burned over in three years!

That was the answer given by one forester to my question regarding fire control in one European country.

Space does not permit a description of the condition in each country through which we traveled which would enable one to reach a fair conclusion on how they got that way in fire prevention in Europe. I shall therefore have to resort to some broad generalizations (Mr. Silcox says "all generalizations are dangerous, including the one I'm making") on Germany, Denmark, Sweden, Finland, Austria, Hungary, and Czechoslovakia.

In the first instance we should remember that these countries are operating stands of timber of the second, third or fourth generation. In other words, practically all timber land has been cut over from two to four times, except those areas reserved from cutting for special purposes. This means there is little inflammable material resulting from old age and decay. I saw nothing comparable to our mature or overmature stands. Utilization in one way or another is complete. Tops and limbs are removed for fuel or paper pulp purposes. Needles, twigs, etc., are needed and removed by farmers for fuel or stable bedding. The result is a clean forest floor, except in cases where the deposition of litter is essential to a restoration of soil fertility, and in the more remote sparsely settled regions. While there may be some, I saw no areas of a heavy understory of brush, although young plantations, and they are numerous, are the nearest approach to what we might term high danger areas.

One is impressed with moisture conditions. I saw only one forest where moist earth could not be seen or raised with a slight scraping with the toe of the shoe. While I have no voluminous weather data to support the conclusions, the impression gained from discussions with foresters was that the long protracted dry periods we experience are seldom encountered. Normal precipitation is high in comparison with that in much of our forest

areas and much more evenly distributed through the months of high temperatures (which, by the way, do not approach our highs). High winds at certain seasons are prevalent and might be a serious factor if other conditions were more favorable to fire. We saw numerous windfalls, but a wind-felled tree, occurring on areas too heavily cut, is promptly removed. Wood being the basic resource of most of these countries, waste is unthinkable.

Even though debris is not allowed to accumulate, except on the areas mentioned, and even though climate is favorable, these, in my judgment, are not the main factors responsible for small fire loss.

Due to the dense population in most forest areas, and intensive forestry practices with a very large forest personnel, a fire has little chance to spread once it gets started. On one area of 10,000 hectares there were 150 families, 10 lookout towers manned, and 10 rangers with an overhead of 3 men. This area was reported to be a dangerous one from the standpoint of fire, but the five fires during the past three years burned a total of three and one-half hectares.

The average European as I know him has a great respect for laws. He believes laws were passed for specific purposes, and as a good citizen he tries to obey them. He has been taught for generations that fire not only injures himself, but is a menace to the commonwealth. I heard of no incendiaries. Then, too, law enforcement is quick and sure even on the man who does his best to prevent fire from getting away. To keep in good standing in a community and retain the friendship of his neighbors he must not be responsible for a fire doing damage to his or his neighbor's or the State's property. This deep respect for law and order is reflected in the habits of country folk and city man alike. Seldom do you see the accumulation of waste around farm buildings.

Pride in appearance of home is evident as one traverses the countryside. I use the word waste advisedly. You may find the stable attached to the house, and both solid and liquid materials fully conserved, with their odor permeating the household, but, considering the economic importance, it is not waste and is seldom unsightly. A walk in the parks of the cities will also impress one with order and neatness. Seldom do you see litter of any nature scattered over these areas.

The habit of depositing a burned match, butt of cigarette always extinguished, an empty cigarette package, a discarded newspaper, etc., in a proper receptacle conveniently located, impresses one so forcibly that you find yourself doing the same thing. And I expect this habit is so ingrained in the average citizen that he *thinks* before he discards a match or burning

tobacco when he is out in the woods. My lesson was learned in the city of Breslau when a little boy of seven quietly walked over, picked up and deposited in a receptacle a match I had pinched out and discarded in the gutter.

So in answer to Mr. Headley's question of how Europe gets that way:

(1) Deep-rooted habits of neatness and order.

(2) An ingrained respect for laws and their strict enforcement.

(3) Complete utilization of what we consider waste material.

(4) The absence of inflammable material on the forest floor.

(5) Favorable climate.

But all of this has not come about in a short space of time. It is the result of the pressure of economics—generation after generation of training to obtain a national viewpoint, and an inherent love of trees.

Preservation of Water Containers—A great deal of trouble has been encountered by the rusting of water containers used in fire control work. A 5-gallon water can cost us $2.70, so a rust preventative measure at a nominal cost would soon pay for itself. It was found that there are two methods of preventing rust on the inside of water cans: (1) the use of a rust preventative solution; (2) painting or coating the inside of the can with a preservative.

A rust prevention solution known as Anti-Rust can be secured at $2.95 per gallon in 5-gallon pails and $2.55 per gallon in 55-gallon drums. One gallon of Anti-Rust will treat approximately 60 to 75 gallons of water. The solution is not harmful, but is not recommended to be used in connection with drinking water, as it would affect the taste of the water. Anti-Rust is manufactured by the Radiator Specialty Company, Charlotte, N. C.

The cost of this solution is too high for practical use where a great deal of water is used for fire control.

Coating the inside of the water can with aluminum paint is much more practical and will aid in lengthening the life of the water cans a good deal. Before painting the inside of the can, it should be carefully cleaned by removing any rust spots with steel wool, washing the interior of the can with gasoline then with warm soapy water, and finally rinsing with fresh water and thoroughly drying it. The interior and the outside bottom of the can should then be given two coats of aluminum paint at 24-hour intervals. The outside flange of the lid where contact with the can is made should be wiped with a clean oiled rag at least once each month, or whenever the cans are used and refilled. One pint of common aluminum paint, at 24 cents per pint, will treat about four 5-gallon cans. It has been found that this nominal expenditure for coating the inside of the can is well worth while.—*Gerald S. Horton, Forest Supervisor, Shawnee National Forest.*

LOADING ARRANGEMENT OF FIRE TRUCK

KENNETH B. POMEROY

District Ranger, Oconto District, Nicolet National Forest

A Chevrolet 1935 long wheelbase truck is used as a fire truck on this district. The inside dimensions of the truck stake platform are 6 feet 9 inches by 11 feet 9 inches.

The loading arrangement is shown on the attached sketch and more fully described as follows:

1. A box 24 inches wide, 20½ inches high, and 6 feet 6 inches long which contains all of the 20-man cache tools and equipment, except the eight 10-gallon milk cans and the eight back-pack pumps. By a neat and orderly arrangement all of the tools and equipment can easily be placed in a box of this size. The box is well constructed, braced and painted, and provides seating space for five members of the crew.

2. A box containing a Pacific Marine Pumper sets on top of the tool cache. It has rope handles, and is easily pulled over on to the milk cans upon arrival at a fire so that access can be quickly had to the fire hand tools. Alongside of this box is a sealed box containing the pumper tools and accessories.

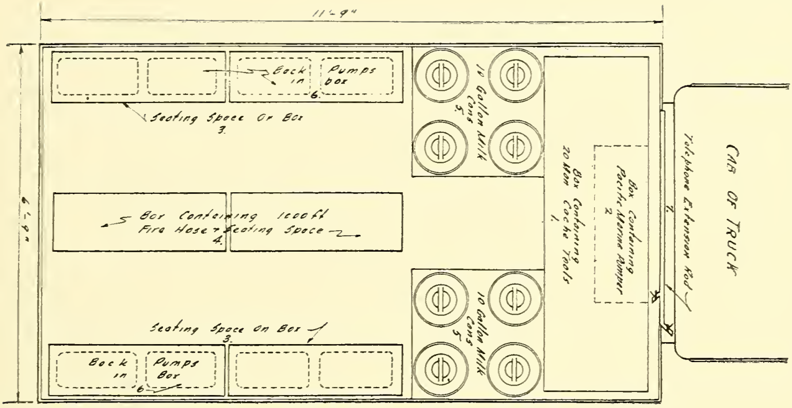
3. Two boxes 11½ inches wide, 18 inches high, and 6 feet 10 inches long, constructed with 1-inch sides and a 2-inch thick top which is hinged. These boxes provide seating space for eight men of the crew. In these boxes are placed the eight back-pack pumps set on rubber cushioning made of old tire tubes; the burlap bags used on grass fires are packed around these pumps. With this arrangement, the same eight cans were used throughout the season without any damage to any of them.

4. A box 18 inches wide, 18 inches high, and 6 feet 10 inches long constructed with 1-inch sides and ends and with a 2-inch thick top which is hinged. This box contains from 1000 to 1200 feet of 1½-inch fire hose, and provides seating for six or seven members of the crew. (300 to 500 feet of hose are carried in the forward end of the truck between the 20-man cache and the stakes of the truck.)

5. Shows the arrangement of the 10-gallon milk cans.

6. Shows the arrangement of the back-pack pumps in the two boxes numbered three.

7. Shows the telephone line extension rod. Two brackets with straps through the loops hold the rod securely in place. The portable telephone is carried in the truck cab.



LOADING ARRANGEMENT OF FIRE TRUCK
OCONTO RANGER DISTRICT
NICOLET NATIONAL FOREST

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and that no paragraphs be broken over to the next page.

The title of the article should be typed in capitals at top of first page, and immediately underneath it should appear the author's name, position and unit.

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually directly following the first reference to the illustration.

(OAKLAND-2-1-37-6000)

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

The value of these publications will be determined by what you and other readers contribute. Something in your fire control thinking or work would be interesting and helpful to others. Write it up and give other men some return for what they have given you.

Articles and notes are wanted on developments of any phase of Fire Research or Fire Control Management: theory, relationship, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting methods or reporting, and statistical systems. Whether an article is four lines or ten typewritten pages in length does not matter. The only requirement is that articles be interesting and worth while to a reasonable proportion of readers.

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AUGUST 9, 1937

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FIRE CONTROL NOTES

AUGUST 9, 1937

Forestry cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and technology may flow to and from every worker in the field of forest fire control.

FIRE RESEARCH IN THE LOWER SOUTH

V. L. Harper

Senior Silviculturist, Southern Forest Experiment Station

This article is adapted from a report prepared by the author pursuant to starting new studies in fire control at the Southern Station during 1937. Some of the fire problems of the southern pineries are presented; and in addition the article exemplifies the type of *problem analysis* and *program* which the author prescribes as a broad guide in planning and carrying out project research.

The Problem Analysis

Fires burned over annually an average of approximately 43.5 million acres[1] in the 11 southern states, or an average of 22 per cent of the total forest area, during the 5-year period 1928-1932. The forests are far from being wiped out, however. Acreage burned and damage done evidently are not closely related, for the reports of the Forest Survey show a tremendous volume of wood still growing. Nevertheless, no one will deny that more growth could have been obtained under management, of which control of fire is a vital part.

During the same 5-year period there was an annual loss in acreage burned of 4 per cent for the 48 million acres of southern forests under protection. Inasmuch as before 1928 there was not much conscious effort to prevent forest fires, 4 per cent may be considered fairly good at the start in a region where man causes practically all of the fires; yet it cannot be overlooked that in this region of rank ground cover it is easier, the human hazard remaining constant, to protect land the first few years than it is after the hazard has accumulated.

Fire Policy in the South

In a region where frequent burning has been the custom ever since the first settlements were made and where the second-growth forests with

[1] Copeland Report.

their wood-working industries still outrank in economic importance all industries except agriculture, it is not strange that there should be questions about the actual effects produced by fire.

It has been a surprise and shock to many to learn that the whole South does not fall nicely into a simple national pattern in which the policy of complete fire exclusion uniformly applies. During the past few years there have been loud and indignant protests from some quarters of the longleaf pine belt against fervent, emotional fire-prevention propaganda. In fact, so serious became the question of fire policy that the Forest Service felt called upon in 1932 to issue a statement[2] recognizing the possibility of using controlled burning in the longleaf pine type.

Although it is admitted, of course, that the South is not uniform and that one policy will not fit all of it, there seem to be two different forms that a fire policy might take:

1. *Should fire exclusion be the public policy with fire used only sparingly, if at all?*

2. *Should controlled burning be recognized in the public policy?*

There appears to be some foundation for the belief that if the latter alternative were accepted as a management measure of respectable standing, more widespread improvement in forest practice might result. In other words, if fire is truly a part of forest management, just as thinning is, should not the emphasis be placed on the condition which requires a treatment of either fire exclusion or some form of controlled fire use? Forest management would then be the main issue and not fire exclusion. As many are quick to point out, the trouble with such a policy is that reform would be slow. Good psychology would dictate making an issue of something simple to preach.

Objections to the first policy are that fuel hazards may build up to the point where protection is impracticable, particularly with the private owner; or, even worse, that complete protection will result in serious ecological disturbances—*e. g.*, that the southern pine type may change to worthless hardwoods, that the game environment may change, etc. Nevertheless, the Forest Service and all southern State forest organizations, I believe, subscribe at present to this or a similar policy. In fact, without more accurate knowledge of the effects of fire, it would be hard to subscribe to any other policy.

[2]"Federal policy relating to controlled burning in cooperative fire protection in the longleaf pine region," by R. Y. Stuart, June 16, 1932.

The Acute Problems

Many difficulties of fire protection in the South spring from lack of sufficient knowledge of the effects of fire. Because fires do less damage in southern pines than elsewhere and appear to have a silvicultural role, the value of a fire policy modified with respect to controlled burning seems indisputable, but there does not exist sufficient scientific data on which to base controlled burning. Damage appraisals, difficult in any region, are even more difficult in the southern forests because the benefits are hard to separate from the detriments. Fire-protection standards or "least P + S + D" objectives, cannot be attempted until more knowledge is gained of the effects of fire.

Regardless of fire policies, protection standards, and controlled burning, there must be fire protection on all soils and types during some stage in the life of the stand, and some soils and stands need fire exclusion all of the time. This unquestionably calls for fire-control technique, and because of the prevalent flashy fuels and consequent rapid rate of spread, the problem of attaining adequate control is not simple.

It would seem, therefore, that three broad objectives should determine the program of the Station's fire project. These are:

1. Better fire-protection methods (fire control, including prevention, presuppression, and suppression).
2. A method of evaluating the effects of fire.
3. Controlled-burning technique.

Emphasis for Next Few Years

Because of the need for information on the effects of fire in order to answer questions raised in regard to controlled burning or in order better to define fire-protection needs, the emphasis in the fire work in the past has been on the study of fire effects rather than on development of protection technique. Although work in the field of fire effects is far from complete, it would seem desirable to give fire-protection research a slight preference for the next few years because of the drive being made at the present time by the Division of Fire Control for better fire-control planning on national forests. This does not mean that the efforts to learn more about fire effects will be lessened, since by a realignment of projects more men are being assigned to the fire project than formerly. Investigations on controlled burning would, of course, be continued as a part of the general study of fire effects.

Specific Work Planned for 1937

Research leading to the practice of handling fire, whether it be controlled burning, suppression, or fire exclusion, may be conveniently grouped according to: 1. Basic studies; 2. Studies on technique of handling; 3. Studies for formulation of policies and plans. The Station is primarily concerned with supplying the first of these, although it should contribute as well toward the other two. In fact, the needs for studies to obtain information on handling technique and policies should serve as a guide to the basic investigations made.

In order to facilitate the formulation of the project program for 1937, a few problems will be pointed out in the various recognized fields of fire control and effects.

Fire Control

I. *Prevention.* Fire prevention is extremely important in the southern pine region. Ninety per cent or more of the unwanted fires are man-caused. The motives for burning vary from pure cussedness or spite to the satisfaction of selfish desires, with a ruthless disregard of the rights of others. This is an enticing field for study, but it does not seem wise at this time for the Station to attempt much work in it, although the Station can furnish technical information on the effects of fire and help define and describe risks and hazards. On the national forests much effort must be exerted in this field; on the new forests this work should be extremely profitable.

II. *Behavior.* Studies in (1) fire protection technique, (2) evaluation of the effects of fire, and (3) controlled-burning practice require certain fundamental data in common. A knowledge of fire behavior, made up essentially of combustion, rate of spread, and resistance to control, is, of course, essential to fire protection and also to certain phases of controlled burning. There seems to be no question in regard to the importance of initiation of work on *behavior.*

1. *Combustion.* A study should be initiated on the Harrison Experimental Forest to correlate moisture content of fuels with weather conditions. Immediate questions to be answered are the effects of rain and relative humidity on the inflammability of fuels. This work will also tie in closely with that on the development of a fire-danger rating scheme mentioned below.

2. *Rate of spread.* The study already started of experimental fires on the Harrison Forest is as much as the Station can carry out this year. The

study is confined to one fuel type, a 2- to 4-year herbaceous rough, and should serve to develop the possibility of experimental burns for this purpose.

3. *Resistance to control.* A study of this does not seem important for the fuel hazards which are encountered in the Coastal Plain forests where the resistance is generally low compared with that under Western conditions. No work other than that already under way in cooperation with Supervisor Conarro and the Regional office (8) should be contemplated this year.

III. *Presuppression—*

1. *Fire occurrence.* At some of the oldest forests—The Ouachita, The Black Warrior, The Florida National Forests, and those under the supervision of the Texas Forest Service—there may be records that are helpful in working out the fire-occurrence expectancy. Little work on this is indicated for the present, aside from what might develop in cooperation with Region 8. It is, of course, recognized that the recent record on some of the new forests gives little or no indication of what to expect in the future.

2. *Fuel-type classification.* This subject needs investigation. At the present time fuel-type mapping in the Coastal Plain forests will not be a large factor in fire-control planning. A correlation can be worked out between fuel type and timber type so that the mapping should be largely an office task. Since maps cannot be revised for ephemeral types such as 1-, 2-, and 3-year roughs or perhaps even for slashings which decay and disappear in 2-3 years, the potential fuel types narrow down to only a few. As a start, the following is suggested as a tentative list:

a. *Herbaceous vegetation.* The open-forest fuel types typical of the Coastal Plan forest west of the Mississippi River, with no shrubby vegetation such as gallberry or palmetto.

b. *Herbaceous and woody vegetation.* The open-forest fuel types typical of the flatwoods, and perhaps of parts of the Upper Coastal Plan east of the Mississippi River.

c. *Forest floor.* The closed stands, where the herbaceous material is mostly shaded out.

d. *Cypress swamps and deep ponds.* Particularly the flatwoods, where shallow ponds constitute a high fuel hazard during the worst season (*i. e.*, dry periods).

Whether the shortleaf-loblolly-hardwoods need to be separated from the longleaf-slash type for purposes of fuel classification, or whether the ex-

isting types will fit into the above scheme, remains to be seen after a thorough consideration in the field and after consultation with men from Region 8.

3. *Fire-danger rating scheme.* This subject warrants considerable attention both from the standpoint of fire-control planning on national forests as well as from the standpoint of State and private forestry. The problem is mainly one of integrating the factors (1) fuel inflammability, (2) wind, (3) season of year, and (4) visibility into fire-danger classes. The number of classes will, of course, depend upon the administrative measures contemplated by the fire organization.

It is noteworthy here that the manager of one large private forest in the Southeast has expressed unwillingness to consider any danger-rating device for his fire organization, because he tries to keep it at maximum efficiency and strength at all times; furthermore, he is inclined to believe that his woods-burning friends might make good use of the information, although they already rank as amateur fire-danger experts.

4. *Time control,* and

5. *Maximum coverage.* These are highly important subjects but depend upon many factors discussed under other headings.

6. *Visibility standards.* Byram at the Appalachian Station is working on a haze-meter for visibility readings for flat country. When this has been developed, the Southern Station should undertake visibility studies. Work on the Harrison rate-of-spread studies has indicated that at times fires can burn for a considerable period before being observed at nearby towers.

7. *Visible-area mapping.* This is not important for Coastal Plain forests. The work of the Appalachian Station should apply to the Ouachita and other mountainous forests in the territory served by the Southern Station.

IV. *Suppression*—Except for the cooperative work being done with the Forest Products Laboratory, not much time of the Station should be given to this class of studies at present. The fire-project men, however, should become thoroughly acquainted with the suppression problems of the Region.

Effects of Fire

One of the largest tasks confronting the Station is to determine the effects of fire so that the average man can make a clear and concise appraisal of the damage done by any fire. Serious attention must be directed toward the making of simple indexes, and of a simple, yet approximately

correct appraisal system. Defoliation which appears to be a good index of damage to surviving trees, for instance, is easily measured. What defoliation means in terms of growth retardation remains to be determined, although what it means in terms of naval-stores yields is already known.

Apparently there is little need to comment in detail on the problems of fire effects. The main thing to stress is that work must be made objective. The desirable final form in which the "effects" data need be presented, should be worked out, and then an earnest endeavor should be made to provide a ready means of collecting the data in that form. A complete evaluation of the silvicultural effects is likely to require a long time, but it is believed that a better basis for making damage appraisals than that commonly used today can be worked out within the near future.

The Fire Project Program

The following long-time fire-program "check list" is presented as a guide in order that the studies may be timely and the development of the program, comprehensive. The foregoing problem analysis, if revised annually to fit new and changing conditions, will provide the basis for placing the current emphasis. The previous year's emphasis needs scrutiny each year in the light of the results obtained and of needs. The subject matter of the present research program, therefore, may need modification or expansion from time to time and is, in no sense, to be considered as final.

A. *Objectives*—

I. Fire-control technique
II. Method of appraising damage
III. Controlled-burning technique

B. *Study subjects* (X denotes current emphasis during present calendar year)—

	1937		
I. Prevention			
1. Risks			
2. Hazards			
3. Educational methods			
4. Law enforcement			
II. Behavior			
1. Combustion	x		
2. Rate of spread	x		
3. Resistance to control			
III. Presuppression			
1. Fire-occurrence scheme	x		
2. Fuel-type classification	x		
3. Fire-danger rating scheme	x		
4. Time control			
5. Maximum degree of coverage			
6. Range-of-visibility standards	x		
7. Visible-area mapping			
8. Transportation			
9. Communication			
10. Fire lines or breaks			
11. Hazard reduction by burning	x		
IV. Suppression			
1. Equipment and supplies			
2. Strategy, tactics, techniques (chemicals, tools, etc.)	x[1]		
3. Fatigue factors			
4. Organization			
V. Effects on—			
1. Mortality	x		
2. Growth (retardation)	x		
3. Soil fertility	x[2]		
4. Watershed values (erosion and water cycle)	x[3]		

5. Naval-stores production	x		
6. Game management			
7. Livestock management			
8. Brown-spot disease (control)	x[4]		
9. Reproduction			
a. Preparation of seedbed	x		
b. Stimulation of longleaf pine seedlings height growth.	x		
10. Stand improvement			
a. Control of species composition	x		
b. Conversion of cover type	x		
c. Pruning and thinning	x		

[1]Chemical suppression is studied in cooperation with the Forest Products Laboratory.
[2]Under "Fundamental Studies."
[3]Some work under "Forest Influences."
[4]Major share of work is being done by forest pathologists.

THE FIRE CONTROL TRAINING HANDBOOK—SOUTHERN VIEW

R. J. RIEBOLD

Training Officer, Region 8

In the January issue of FIRE CONTROL NOTES J. F. Campbell, of Region 6, gave a progress report on the Fire Control Training Handbook, which was begun by a conference of fire and training men from Regions 1, 4, 5, 6, 7, and 8 in Portland last December. The conference prepared a manuscript which was turned over to Ray Linberg, Personnel Training Assistant in Region 6, for editing. Since Campbell's report an edited copy of the Handbook has been returned to the members of the conference for review and criticism, and a final draft of the Handbook submitted to the Chief. Mimeographed copies of the Handbook have been distributed to all Regions for use in training fire control personnel this year.

It has been definitely planned that during the winter of 1937-38 the present mimeographed edition of the Fire Control Training Handbook will be reviewed by a group representing all Regions. Members of the group are expected to bring to the conference their experience in using the Handbook during the current year and from their experience to be able to include in the Handbook an abundance of material illustrating the application of principles and practices in the training of fire control men. It was the consensus of the Portland conference that illustrative material must be noted in detail at the time the incident occurs if it is to be of real value. It is suggested, therefore, that Regional fire and training men keep notes of experiences they have in training work throughout the year so that they may bring these experiences to the conference next winter. It is fully expected that the Handbook as revised and expanded as a result of this conference will be printed in final form and will be available to all fire control agencies within and without the Forest Service in the spring of 1938.

An attempt was made at the conference in Portland to make the Handbook usable to all forest fire control agencies, in the face of the realization that conditions differ widely in various parts of the country. It may be of interest for those who have not served in the Southern Region to note a few items of the 1936 fire season in Region 8 which make the fire control training job there somewhat different from that in western regions. Before any training program can be planned it is the job of the training officer to analyze the training needs which the situation presents. Most fire training, for example, is planned to take place just before and during the fire season, but in the Southern Region in 1936 there was not a single ten-day period throughout the year in which fires did not occur.

During the year the national forest organizations fought 4,152 fires,

which burned a total area of 156,000 acres. If any part of this year-long campaign can be called a "fire season," the period from February 20 to May 10 is probably it. During this period 49 per cent of the total number of fires burned 76 per cent of the gross national forest area lost. The worst ten-day period during the year was that of March 10-20, in which 445 fires burned 26,306 acres of Forest Service protected lands.

The fire suppression organization is not proud of this record, but is not ashamed of the fact that the average fire was only 37 acres, that even during the worst part of the spring season the average fire was 60 acres. Of the 4,152 fires, 12 per cent were class A's, 55 per cent were class B's, 33 per cent were class C's. Eighty-three per cent of all reportable fires were discovered within one hour; in fact, 65 per cent of them were discovered within 15 minutes. Getaway time was within 5 minutes on 83 per cent of all reportable fires and within 15 minutes on 97 per cent of the fires. Of all fires, 76 per cent were corralled within one hour and 98 per cent within six hours.

Although regional average figures are often deceptive and dangerous generalizations, these figures indicate generally an organization that is on its toes in suppression work. The task of training appears to be one of keeping this organization up to scratch in spite of the turnover of personnel, of keeping it abreast of new technological developments, and of stimulating its inventive ability to devise new and better techniques to meet its own particular fire suppression problems.

The record in fire prevention is much poorer. Only 8 per cent of all the reportable fires were caused by lightning. Of the 3,809 man-caused fires 43 per cent were of incendiary origin. The man-caused fires that were actionable totaled 3,775, but action was initiated on only 11 per cent. Law enforcement action was initiated on only 3 per cent of the incendiary fires. Although there are other factors, and important ones, also involved in the fire prevention job, surely this picture reveals that training has a real need and a real opportunity. Before judging this record too severely, Yankee foresters would do well to try catching the elusive woodsburner in the flat, easily accessible, populous forests of the South.

In the Southern Region there are practically no one-man fires. The rapid spread of grass fires means that every fire must be handled by a fire crew. Practically all fire fighting is done by CCC enrollees, which means that every CCC foreman and superintendent in the Region must be well trained in crew management in fire suppression. All district forest rangers, assistant rangers, ECW supervisory personnel and selected enrollees must be

trained in fire prevention work and particularly in the investigative part of fire law enforcement work.

Of course, fire training camps are now held on every forest every year for staffmen, rangers, assistants, and camp personnel, and on most forests systematic training in fire suppression is given to all enrollees in CCC camps. On some forests fire training is given enrollees every month.

The situation faced by fire control training in the Southern Region suggests that the first and most urgent job of training is to put into the heads and hands of all personnel a knowledge of and ability to use better training methods. The new Fire Control Training Handbook will be very valuable for this purpose. It will be used with the full understanding that training methods cannot be learned by reading a handbook.

Training methods will be taught by assembling in training schools of two weeks' duration similar groups of men, such as assistant forest supervisors, fire assistants, superintendents of construction, administrative assistants, and district forest rangers—one from each forest—at the rate of a group a month throughout the year, to learn by doing under coaching. The handbook then will be to these men a textbook and a reference book, each page of which will be full of meaning to them because of their own individual experience in learning training methods in the training school. The men will in turn apply these better training methods to the training of project superintendents, foremen, dispatchers, lookouts, contact men, investigators, and fire fighters.

There must be added to the large amount of technical knowledge and skill in fire control possessed in varying degree by all fire control personnel the means of transmitting that skill, knowledge and ability to other people in the most efficient manner. It is believed that the means to do this are contained in the training methods concentrated in the Fire Control Training Handbook. The more actual experience of fire control men in training work that gets packed into that Handbook, the more valuable it will be.

FOREST FIRES AND FIRE WEATHER IN NORTH FLORIDA

Archie W. Budd

After more than 5 years of weather recording to determine what relation exists between weather and fire, this author has reached the conclusion that human behavior rather than weather behavior is the malign influence.

There does not exist a close relationship between fire weather and forest fires in the longleaf and slash pine forests of North Florida. It has long been the custom in this region to burn over the forest frequently for one reason or other and the will to burn still persists to such a degree that even on forests in which complete fire protection is sought the human element looms up as a major factor in the occurrence and behavior of fire.

This is the general conclusion which the writer has reached following analysis of several years' records of fires and weather. Records have been kept since January 1, 1932, at Middleburg, Florida, the headquarters for the 14,000-acre property of Budd Forests, Inc. The purpose of the weather readings and fire records was to seek any correlation of weather with fire occurrence and behavior which might help develop more effective fire control.

The analysis of the records showed that 50 per cent of the fires that burned 50 or more acres per fire occurred when the temperature was above average for the season and relative humidity below average—obviously a bad fire weather combination with respect to these two elements of weather. On the other hand, a good many fires occurred when these two elements of fire weather were not the most favorable for serious fires, as 100 per cent of all fires occurring in the class of 20 or more fires per day occurred when the temperature as well as humidity, etc., were below average. The percentage of fires in the various classes are given in table 1.

Table 1. The number of fires from the fire seasons of 1932 to 1937 inclusive as they occurred with reference to classes of temperatures and humidity, number of fires per day and area of burn per fire.

Temperature and Relative Humidity	Fires from 1932 to 1937				
	Fires per day			Area of burn per fire	
	10-14 in number	15-19 in number	20 or more in number	20 to 50 acres	50 or more acres
Temperature above average; and relative humidity below average	50	40	0	22	50
Temperature below average; relative humidity below average	12	20	100	22	20
Temperature above average; relative humidity above average	38	40	0	34	20
Temperature below average; relative humidity above average	0	0	0	22	10

The figures of table 1 strongly suggest some factor other than weather which is operating particularly to start fires. This factor is, of course, the habitual frequent burning practice so strongly rooted in the South. Turpentine operators, cattle men and other willing helpers for one cause or another are wont to burn the woods in December, January, February and March. Table 2 shows the average acreage burned and numbers of fires for November to April inclusive.

Table 2. Average temperature, relative humidity, acreage burned and number of fires by months for the years 1932-37, inclusive.

Month	Average Temperature Degrees F.	Average Relative Humidity Per Cent	Area burned per fire Acres	Fires Number
November	69.27	60.43	21.[illegible]1	66
December	64.56	65.67	22.26	146
January	66.55	64.57	27.24	197
February	64.57	62 59	23.41	201
March	70.98	55 01	14.89	249
April	77.26	54.78	13.17	45
Averages	68.93	60 73	22.1745	

More fires occurred in March than in any other one month and they averaged next to the smallest in acreage burned. The explanation of this is probably that the green grass and other vegetation served as a retardant to the rate of fire spread which more than offset a lower average relative humidity than for any of the other winter and spring months save April. Wind is a big factor in fire behavior but no data are available for the Budd Forest.

The general conclusion from the study as well as experience on the Budd Forest is that the strongest correlation of fires is with people and that fire prevention is a big part in fire control. There are lots of days that fire will burn, and so long as the local people continue to burn the woods for their own purposes without regard to the wishes of the owners the total acreage burned is bound to be large.

RADIO AND FOREST FIRE CONTROL IN FLORIDA

H. J. Malsberger

Assistant State Forester, Florida

The broadcasting system here described is, in many respects, a very effective use of radio in fire control, but one on which opinions vary widely. The U. S. Forest Service is not convinced of the wisdom of a system which permits no "answer back." In most situations it is essential for the dispatcher to *know* that the crew has received the message and has acted upon it.

The Florida Forest and Park Service took the lead in Florida in experimenting with short wave radio communication in forest fire control. A station was established in November, 1936, at the Dinsmore Ranger Station in Duval County 14 miles north of Jacksonville.

Duval County, where the County Commissioners rather than individual land owners cooperate with the Florida Board of Forestry, was the first County in the State to embark upon a program of County fire control. Now 268,954 acres are under protection. This station was located also for the purpose of serving the cooperators in the adjoining County of Nassau, whose lands total about 100,000 acres. It is reasonable to expect that all of the forest lands in both Duval and Nassau Counties, totaling nearly 759,000 acres, will be listed for protection in the near future. This general area was, therefore, most appropriately selected for the initial attempt.

Collins Type FXB Transmitter

This station is operating through a permit issued by the Federal Communications Commission under a "special emergency license" classification. The station has been assigned an operating frequency of 2,726 kilocycles with the call letters WANB and has an output of 100 watts.

The transmitter is a Collins type FXB. It is an amateur set but was converted for commercial use by the addition of protective devices. These automatic, protective devices consist of an overload trip and time-delay relay which prevents damage to the equipment by accidental overloading.

Information is transmitted by using voice modulation only, rather than code, because the personnel are not trained in receiving messages in code. The use of code would allow the installation and operation of smaller equipment and less power would be required to reach the same distance.

The feature of the station is the frequency control, made possible by a special crystal ground to exact frequency, which is installed in an oven

Acknowledgment is made to Mr. John P. Bryan, radio operator and chief dispatcher at the Dinsmore Ranger Station, for his collaboration in assembling the information contained herein.

which automatically maintains a constant temperature of 53 degrees C. The assigned frequency of the station is checked twice a month. The operator has been exceptionally successful in staying within a very slight variable of the allowable frequency tolerance specified by the Federal Communications Commission.

The approximate cost of the transmitter which is now being used by the Florida Forest and Park Service is $800.

Control Points

The station has two control points, one located in the county ranger's office and a remote control point in the lookout tower. This arrangement makes it possible, under ordinary fire conditions, for the radio operator to be the lookout and dispatcher at the same time. During the peak of the season, however, two men are required. The advantage of having a remote control point in the observation tower is that the radio operator can keep in closer touch with the condition of going fires, and is thus enabled to keep better control of the crews.

The remote control point must be equipped with a modulation monitor in order to determine that the station is operating correctly when the operator is removed from the transmitter. It must also be equipped with a receiver and a switch to turn the transmitter off and on. The cost of this additional equipment amounts to $150 but is well worth the investment because it provides a more flexible system of broadcasting.

Station Receiver

The receiver in the station is designated as the "station receiver" to differentiate it from the receivers in the trucks. It is a RME 69 model. It is a communication, band-switching, superheterodyne type of receiver, covering a frequency range of 550 to 32,000 kilocycles. The band-switching and large-range features are the important factors of this receiver as contrasted to other types which have a limited field. The wide-frequency range is not absolutely essential but is desirable in the event the Federal Communications Commission may change the frequency or assign another frequency to the Florida Forest and Park Service to take care of portable mobile equipment used in two-way communication. The present equipment is flexible enough to take care of such a possible situation.

The cost of this equipment is $150.

Antenna and Ground

The antenna and ground can properly be considered to be the most important single item of the station. The dependability of reception over the

area is governed by this equipment. The objective in the construction of a forest fire control radio station is to concentrate power, which is equally radiated in all directions around the transmitter, along the surface of the earth. If the antenna is located near the center of the protected area it must be absolutely non-directional in order to assure proper reception in areas of the control unit.

The concentration of power along the surface of the earth is also essential to secure consistent reception of messages 5 miles distant from the transmitter as well as 35 miles or more. Station WANB was constructed for the purpose of obtaining a 40-mile radius. Consistent coverage has been checked and found that reception is satisfactory within a radius of 30 miles. No tests have been made beyond this point but indications are that the reception will be satisfactory within 40 miles.

The strong ground wave is accomplished by the use of a quarter-wave Marconi antenna suspended vertically from a 95-foot pole. A number ten copper wire is used on the pole for the antenna. The Department of Commerce requires poles erected within ten miles of an airport or airway to be painted. It is, therefore, essential that the pole be not creosoted but be treated with some other preservative.

At a point in the ground, exactly beneath the center of the transmitter, a 12 x 16-foot copper-mesh screen is buried 8 inches deep. A 20-foot section of 1½-inch galvanized iron pipe establishes a permanent ground to which is attached the screen. Sections of number 12 copper wire are soldered to the screen and extend radially from it. The 84 radials are 87½ feet long and the wire is buried 6 inches in the ground and terminates in a 6-foot galvanized ground rod. The wires were easily placed in the ground, without disturbing much sod, by the use of a dibble.

The complete cost of the antenna and ground is about $300.

Incidentally, part of the power reaches the sky wave and is used for contacting monitor stations at distant points for frequency tests. Cards verifying reception have been received from short-wave enthusiasts as far north as the New England and Great Lake states. This same power could be used for communicating with forest fire control stations at distant points to check on approaching weather conditions and for exchange of other valuable information.

Microphones

Crystal microphones are used at both transmission points, thus eliminating batteries which would be necessary if carbon microphones were used. They are Shure type 70 S. These instruments are made especially for voice

frequencies. They cost $15 each and two are in use, one in the station and the other in the tower at the remote control point.

Control Panel

The control panel and table were made by the operator and are constructed of tempered Masonite to which was applied a coat of lampblack. The unit is entirely satisfactory and cheap, costing $25 complete. It employs a foolproof switching device arranged so that the two control points could not possibly interfere and have two people talking at the same time. This is a very necessary safeguard due to having a remote control station in the cabin of the tower. It is necessary to keep an accurate electrically-operated clock to regulate the proper times to go on the air.

Receivers in Trucks

Philco types 810 PV and 811 PV (police variable) receivers are used in the trucks of the Florida Forest and Park Service and ECW organizations. This equipment has a tuning dial instead of a fixed frequency which makes it more valuable because it can receive messages broadcast from stations having different frequencies than that assigned to this station. It means further that the equipment need not be altered if this station's frequency is changed. The receiver is widely used in police radio systems and costs $35.

A feature of this equipment is the loop-receiving antenna attached to the top of the cabs on the trucks. The antenna mounting is constructed of oak and a metal frame. Number 12 copper wire is threaded inside the mounting on bakelite insulators. This antenna is cut to approximately a quarter-wave, 92 feet of wire being used in this case. The efficiency of such a loop-type antenna is largely responsible for the very successful and strong reception received in the field. It is impossible to stress too greatly the necessity for sturdy construction of a mobile antenna on account of the hard usage given it by trucks traveling through the woods over woods trails. It would seriously affect the suppression work to be constantly repairing the equipment during the peak of a fire season.

The loop-type antennae cost $22 each, but they can be constructed for $10 each when using your own labor.

Operation of the Station

The radio operator commences testing at 9 a. m. and tests each hour thereafter until 6 p. m., unless weather conditions demand a longer service. If the fire danger is great, tests are broadcast each half hour. A fire call is broadcast at any time a fire occurs. The receivers in the truck are kept on

constantly, if there is any fire danger, to receive the calls. Specific locations of all fires are broadcast and the county ranger is kept informed of conditions over the unit at all times.

Service Parts

It is very important to the successful operation of a radio station to keep an ample supply of service parts for emergency use. This station carries service parts and test equipment valued at approximately $150.

Operating and Replacement Costs

Cost of power for the transmitter, averaged over a five-months' period, amounts to $6 per month. This includes battery charging for Florida Forest and Park Service and RCW radio-equipped trucks and is based on a cost of 3½ cents per kwh for current.

Frequency monitoring service required by the Federal Communications Commission costs $5 per month. The cost of tube replacement and maintenance of the transmitter and station equipment is estimated at $50 per year.

Maintenance of truck receivers is estimated at $5 each per year, totaling $75 for the 15 receivers operating in the Duval-Nassau unit.

The life of the antenna and ground system is estimated at 20 years, making a cost of $15 a year for replacement. Summarizing, the total estimated cost of operation and maintenance, excluding salaries, for the radio system amounts to $272 per year.

Organization

One man is employed as radio operator and chief dispatcher who has a second-class radio operator's license. He is aided by an assistant operator and dispatcher who has a third-class operator's license. The duties of these men have been mentioned and in addition it is their responsibility to maintain all radio equipment and receivers and repair telephones.

Conclusion

In summarizing the radio equipment, it is our opinion that the most important factors guaranteeing the successful operation of the station are good antenna and ground for the transmitter and antenna for the truck receiver. These factors make it possible for a transmitter of 100-watt capacity to do a satisfactory job which otherwise might require a 500-watt transmitter. The latter equipment is much more expensive. The total cost of the complete radio installation amounts to $2,610.

The station is now completing six months of service through a partial fire season. It is too early to draw definite conclusions on the exact value of radio communications used in conjunction with a tower and telephone system in the suppression of forest fires.

Several outstanding values of the radio are listed. It materially increases the speed in dispatching fire crews because they can start before the triangulation of the fire is completed and be informed en route of the actual location. One towerman can locate the fire accurately enough to start the crew in the right general direction. It permits the organization to be very mobile, which is of primary value. Crews can be patrolling the woods during hazy weather of low visibility or patrolling to prevent timber theft. The crews are not required to remain stationed at a tower or telephone. This permits labor crews to work on forestry improvement projects, such as thinning, planting, etc., and still be immediately available for fire suppression work. A man remains in the truck to receive the fire messages in such instances and then collects the laborers.

The use of the radio also materially reduces the mileage and consequently the wear and tear on the trucks. Quite frequently trucks are dispatched to fires en route to the tower or reporting telephone before the complete trip is made. The radio station is located at the central dispatching stations which permits the operator to know where the crews are at all times.

It is not possible to ascribe definite improvement of results at this time entirely to the installation of the radio system. It is apparent, however, that the crews and the entire organization rely to a great extent upon the system. A statement was made that if they had their choice between a tower and telephone system and ten trucks with no radio, and a tower and telephone system and five trucks and the radio they would take the latter.

The radio system alone does not cost quite as much as five trucks, and when salaries, operation, and replacement costs of the trucks are considered, the comparison is greatly in favor of the radio even from a strictly financial standpoint. In addition, the psychological effect of radio on the public is undoubtedly a distinct asset in forest fire control work, especially during the early stages of such a program.

RADIO INTERFERENCE

A. Gael Simson

Radio Engineer, Region 6

With increasing use of radio, especially of the ultra-high frequencies, interruptions of Forest Service radio communication by various noise-producing devices, such as heating pads, neon signs, electric motors and diathermy apparatus, are becoming more and more prevalent. The diathermy apparatus (machines for producing artificial temperature in patients) is becoming one of the worst offenders because the use of such machines is spreading rapidly and because the interference range of the equipment is considerable. These machines have created heavy interference over distances of several hundred miles.

Medical men as a group are very cooperative in reducing interference from medical apparatus, when the interference is brought to their attention. The remedy is usually to shield the equipment room and insert chokes in all wires leading into the room. Occasionally, however, an owner or user of diathermy apparatus refuses to quiet it. Almost invariably this attitude is a result of his ignorance of his responsibilities.

When all other means fail, it may be helpful to refer the diathermy owner to the following excerpt from the Communications Act of 1934:

Section 301. It is the purpose of this Act, among other things, to maintain the control of the United States over all the channels of interstate and foreign radio transmission; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license. No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio (a) from one place in any Territory or possession of the United States or in the District of Columbia to another place in the same Territory, possession, or District; or (b) from any State, Territory or possession of the United States, or from the District of Columbia to any other State, Territory, or possession of the United States; or (c) from any place in any State, Territory, or possession of the United States, or in the District of Columbia, to any place in any foreign country or to any vessel; or (d) within any State when the effects of such use extend beyond the borders of said State, or when interference is caused by such use or operation with the transmission of such energy, communications, or signals from within said State to any place beyond its borders, or from any place beyond its borders to any place within said State, or with the transmission or reception of such energy, communications, or signals from and/or to places beyond the borders of said State; or (e) upon any vessel or aircraft of the United States; or (f) upon any other mobile stations within the jurisdiction of the United States except under and in accordance with this Act and with a license in that behalf granted under the provisions of this Act.

This section appears to give the Federal Government power to abate radio interference. It has not yet been passed on by the courts and at the present time it is not desirable officially to take action under the above section. Nevertheless, it does have value as a moral force.

DOES SALT AFFECT THE STAMINA OF THE FIRE FIGHTERS?

A. A. Brown

Fire Control, Region 2

At the Spokane Fire Conference held in February, 1936, the question of the possible value of salt as a stimulant to the fire fighter working under conditions of great heat and exertion was brought up for discussion. Little could be offered on the subject by any of the forest officers present, and it was set up as a subject in need of investigation, which was later assigned to Region 5 for report. The following article represents authoritative information which it has been possible to assemble from available authorities and original sources.

The phenomena of heat exhaustion and the new techniques in its treatment, which have lately assumed prominence in medical literature, are of very practical interest to foresters. Heat disorders are revealed caused by a condition of disturbed fluid balance of the body usually induced by loss of salt and water through excessive sweating. Consequently, treatment is concerned primarily with restoring both salt and water to the blood stream and tissues. Injection of salt water into the veins is sometimes resorted to by physicians.

Quite naturally this question arises: "Can heat exhaustion not only be avoided, but can the wellbeing and efficiency of fire fighters or other forest workers exposed to hot temperatures be improved by prevention measures designed to maintain the chloride balance?"

Special reference is made to the paper by Dr. R. O. Schofield on "Heat Prostration—Its Treatment at Boulder Dam," which was read before the California Medical Association at Riverside in 1934. This paper has since been the subject of considerable discussion both within and outside of medical circles.

Dr. Schofield expressed the belief that increased use of both salt and water at Boulder City had been the most important prevention measure in decreasing the number of heat cases. Accordingly, suggestions have been made that such expedients as putting salt in the fire fighter's drinking water, equipping him with salt pills, or giving special attention to inclusion of salty foods in fire camp mess, might well be valuable provisions for maintaining the fire fighter's stamina under conditions of extreme exertion at high temperatures.

The possibilities of preventing heat cases by the use of salt in this way may be best examined by reference to the medical literature on clinical treatment. Three types of heat disorders occur. These are tabulated as

follows with comparative descriptions of clinical manifestations and modern treatment:

Condition	Pathological changes	Clinical features	Treatment
Heat cramps	Loss of sodium chloride	Cramps	Salt and water by mouth. Perhaps hypertonic saline solution intravenously.
Heat exhaustion Heat prostration	Circulatory failure from insufficient blood volume	Fainting, prostration, collapse. Skin cool, moist. Blood pressure low. Temperature subnormal or slightly elevated. Pulse small, soft.	Fluids, especially normal saline solution intravenously. General treatment for collapse.
Hyperpyrexia	Failure of sweating	Delirium, convulsions and coma. Skin dry, hot. Temperature 41.7° C. (107° F.) or more. Pulse rapid, full.	Cold water spray and fan.

Comparison of the Essential Features of the Different Disorders Due to Heat

Heat cramps usually occur in men who have become acclimated to physical exertion at high temperatures, as far as exhaustion and hyperpyrexia are concerned. Cramping usually occurs during or after a period of heavy sweating induced by physical labor after copiously drinking water.

The explanation offered is that the body loses both salt and water through sweating during exertion. When water alone is taken in sufficient quantities, the chloride balance of the system is upset. This unbalance changes the osmotic action of fluids to the muscles and the difference of fluid pressure is manifest in muscular cramps. Salt added to the drinking water will decrease the osmotic fluid pressure and prevent or alleviate cramping. There is apparently a correlation of occurrence of cramps to a previous intake of alcohol.

Heat exhaustion and prostration are caused by circulatory failure due to a depletion of the blood supply. The body so guards its chloride balance and temperature that water and salt lost in sweating is taken at the expense of the fluid portion of the blood. Treatment in this case is the intravenous injection of saline solution. Intake of water, or better still salt and water, should aid in preventing prostration cases.

Hyperpyrexia is brought about by the failure of the sweat glands. Research revealed no cause for failure other than phsiological diseases. This failure *may* be brought about by the lack of water in the system. While I

have found nothing to substantiate this claim in reference texts, it seems reasonable that if there is an abundance of salt in the system, the sweat glands will no longer function because the chloride balance is such that to lose more water through sweating would result in a too high concentration of chlorides in the blood. If this be so, then the use of salt as a preventative measure in heat disorders would aid in the cases of cramps and in prostration and exhaustion but might cause greater frequency of hyperpyrexia.

Statements of Authorities

Major Henry A. Brodkin, Military Medical Surgeon of the National Guard, in a series of observations with men not acclimated to long marches in hot weather has classified the appearance of the men into three groups:

> The first was the man whose face was flushed, perspiring moderately; his pulse was full, strong, and somewhat accelerated, his khaki woolen shirt was dark with perspiration about the neck and wrists. He appeared alert, although somewhat tired, and responded quickly to commands.
>
> The second type was the man whose face was almost plethoric and covered with perspiration; his pulse was strong but quite rapid, his breathing was rapid and deep, his shirt was dark with perspiration about the neck, shoulders and wrists, and his skin hot to the touch. He looked tired as though he would welcome a cot in the shade and he responded slowly to commands and questions.
>
> The third type was the man whose face was pale and covered with beads of perspiration; his pulse was thready, his respirations were rapid and shallow, his khaki shirt was dark and soaked with perspiration, and his skin was cool and clammy. He looked as though he were ready to drop in his tracks, although he marched along doggedly and automatically, and responded to commands with great reluctance and effort. This is the stage just before he becomes a march casualty unless he is rested or given proper treatment.

Brodkin found these classifications to correlate directly with the amount of water consumed during the march. His opinion is that the chloride balance in the blood has been upset, and that salt taken either in drinking water or by encoated pills might alleviate many march casualties. His conclusion is offered as a suggestion rather than a specific preventative of heat disorders.

The question was referred to Dr. L. Porter, Dean of the University of California Medical School, who recommended Dr. C. L. A. Schmidt and his associates in biochemistry at U. C. as the men best qualified to speak with authority on such a subject. Dr. Schmidt has been most generous in his desire to cooperate, and met our request by bringing the question before a graduate seminar of his associates. They have discussed the question with great interest and Dr. E. S. Sundstroem, prominent authority on tropical physiology, has submitted the following comments:

When large amounts of water enter the body, this water leaves the body either through the kidneys, or through the skin as sweat, or it evaporates as insensible perspiration or through the lungs. Which of the routes the water will take will depend in large part upon the prevailing temperature and humidity of the environment.

Most of the water is excreted in the urine under normal atmospheric conditions. When both temperature and humidity are high, a considerable part may be lost in the sweat. When the temperature is high but the humidity is low, while visible perspiration may still play an important role, especially during heavy exercise, the insensible perspiration will acquire an increasing importance for removing water.

It is well known that when the water is excreted by the kidneys, the chloride excretion will rise considerably and that this may ultimately lead to a depletion of the body chlorides. Whether this chloride depletion is the only cause of the toxic symptoms which occur in such cases is not absolutely certain. That this depletion is responsible at least partly for the toxic symptoms is evident because adding salt to the drinking water will relieve them.

It is known also that similar toxic symptoms, although less severe, may arise when the water is removed as visible perspiration. The experiences in hot and humid mines serve as an illustration of this. Since the sweat contains considerable amounts of chlorides it may be inferred that chloride depletion enters the pathological picture also in these cases. Supplying salt in the drinking water is based upon sound physiological principles also in this kind of emergencies.

So far as we know, it has not yet been shown experimentally what happens to the chloride balance when the water evaporates directly. It would seem that the chances are relatively small that a more serious chloride depletion would occur in such cases. It could even be inferred that the chloride concentration in blood and tissues would rise, especially when the amount of visible perspiration is reduced proportionately to the insensible perspiration. It is doubtful, however, whether this could happen during such exerting work as, for instance, a fire fighter has to do.

Most forest fires occur on hot and dry days. It would seem then that the conditions with which the fire fighter has to contend fall in the class in which the insensible perspiration is, or at least ought to be, the predominant factor in removing the large amounts of water the fire fighter drinks. The insensible perspiration is, or should be, the main mechanism his body uses to prevent hyperthermia. It is undoubtedly the hyperthermia which causes heat prostration.

Suitable clothing, allowing efficient body cooling, and eventual wetting of this clothing to promote evaporation of water without drawing upon the water resources of the body too much are probably the most important measures to prevent heat prostration in the fire fighter. In case the clothes are wetted, the chilling effect should not become dangerous before the work is over. Proper measures should be taken, however, to prevent excessive chilling at rest.

Determining approximately the amount of work the fire fighter does in calories, it ought to be possible, knowing the environmental conditions, to calculate the volume of water a fire fighter will need per hour. If the water intake is kept within this limit, and if unnecessary water drinking is discouraged, the addition of salt to the drinking water does not appear necessary. On the other hand, a small addition of salt should not be harmful in any respects.

Discussion

A great volume of other references add but little to known facts, although a whole field of medical literature and of biochemistry bears on the subject indirectly.

It is evident that the chlorides bear an important relation to the ability of the body to regulate heat, and that salt plays a role hitherto unsuspected by the layman.

Doctors are not willing to say definitely that salt taken in the drinking water is a specific against heat disorders, though none have held that it would be detrimental.

The evidence seems to bear out the old timer's advice against drinking too much water under conditions of extreme exertion and sweating. Perhaps we can now add "unless accompanied by a corresponding intake of salt.

Dr. Sundstroem's comments may reveal the reasons for the remarkably small number of clinical cases of heat prostration in fire fighting. At the same time they call attention to the sound reasons for using salt as a prevention of heat exhaustion under certain circumstances.

In conclusion, it may be said that forest officers in charge of fire crews should inform themselves as fully as possible on this subject as a part of their responsibility and should give conscious attention to supervising the water intake of the workers, to preventing excessive sweating, and to insuring an adequate supply of salt in the fire mess diet. In addition, since experience is the best guide of all, the issuance of controlled amounts of salt to test crews under severe conditions of heat and exertion should by all means be tried and comparative results recorded in as much detail as possible. In many cases, CCC army doctors might cooperate effectively in such tests.

Reading the Firefinder at Night—The Osborne firefinder can be easily adapted to night detection with no other special equipment than an ordinary flashlight. The volume of light which this affords should be cut down to a small pinhole beam by inserting between the reflector and the lens a disk of black paper in the center of which has been punched a small hole. The wire from a gem clip can be used for this purpose. The small beam of light thus produced causes no reflection from windows.

Talcum powder, or even flour or baking powder, is dusted lightly on the wire (or hair) of the sight. The beam of light can be so directed against the wire as to dimly illuminate it without interfering with vision.—*E. W. Donnelly, District Ranger, Ochoco Natonal Forest.*

THE FUTURE OF FIRE CONTROL

John R. Curry

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The emergency aspects of fire control loom large. The ever-present possibilities of disaster tend to confine fire control thinking to matters of the moment, the day, and the season. Seldom, therefore, do foresters stand off to consider this problem in its broader aspects, or to consider the gains which fire control is making relative to long-time needs.

It would be well for the men interested in this field to scrutinize our present attitude toward this work and our organization for it, to determine whether this problem is being approached logically. Is our organization such as will enable us to obtain the maximum improvement within this field? Does fire control offer to professional foresters the opportunities found in other fields of forest administration? Should forest fire control be regarded as a major field of the profession of forestry in America? If so, is it gaining this recognition?

In the opinion of the writer, fire control development is handicapped by the old idea that the fire problem is one of temporary importance; that eventually, as a result of certain emergency measures to be taken during the present or the near future, this activity will rapidly diminish in importance. There seems to be a hope that fire in America will eventually reach the minor status which it has always held in the managed forests of Europe. This line of reasoning I hold to be wholly fallacious. Not only do present trends in fire business indicate this fallacy but our increasing knowledge of fire behavior also points the error.

It is a matter of record that the fire problem is increasing steadily in importance with increasing use and higher values. The time may arrive when fire losses will be reduced to a point where they do not offer a serious obstruction to forestry practice, but the period when fire problems will not challenge to the utmost the ability and ingenuity of American foresters will arrive only if American climate, American forests, and American people change essentially from what they are today.

Men who have been engaged in fire control work for the past 15 or 20 years are, I believe, ready to agree on the long-time, continuing importance of fire problems. If so, these men as a group should make their feelings known, that this activity may receive equal consideration with other professional problems.

Failure of foresters to recognize the long-time characteristics of the fire

control job is responsible for the present lack of specialized organization and development in this field. Foresters have not approached the problem in a professional manner because they have hoped from the beginning that the fire problem could be solved by a few years of intensive educational effort. Despite such efforts a fire problem still exists. How should foresters approach it as professional men?

The professional approach as I see it starts with a detailed analysis of the job. Essential to the professional approach is a program of action which provides, first, for an understanding of the basic principles involved and, second, for the development of skills and techniques to gain the objectives.

Forestry's present store of information and accepted skills and techniques in fire control are meager. Consequently, the instruction provided in professional schools is entirely out of proportion to the importance of fire control in the field of forestry practice. The young forester finds himself ill prepared for the job which often consumes the greater part of his efforts. The difficulty seems to be principally a matter of organization. Fire control cannot complain of neglect in the relative distribution of funds. Have these funds been used to the best advantage considering the long-time nature of the work?

On the national forests at the present time there is little specialization in fire control. Fire work is handled by general administrators. Although these men may have a consuming interest in the job, they have scant time to give to the development of technical problems. Other important phases of forest administration, such as grazing, forest management, and engineering, have each their specialists, while the most important job of all is administered directly by the supervisor, necessarily a man whose attention cannot long dwell on a single activity. The complicated jobs of prevention, of selection and training of men, of planning detection, communication, transportation, and of organizing for fire suppression, are the responsibility of everyone, and consequently the direct responsibility of no one.

In the Regional Offices reorganization is also desirable. The attempt to organize the branches of fire control in certain western regions was, I believe, a move in the right direction and one which should be revived. At present, fire control is ordinarily administered by an assistant to an Assistant Regional Forester. It is placed, along with other miscellaneous or general jobs, in the Operation division. Fire control consequently does not receive the attention which it should in the formulation of administrative policies and plans. The chief of fire control attempts, even in important

fire regions, to administer the job with a handful of assistants. Considering the amount of money spent in this field, the lack of administrative overhead is obviously inefficient management.

A Division of Fire Control has been created in the Washington Office, and this is a big step toward recognition of this field. As yet, however, the Division comprises only three men, a force which is obviously inadequate to promote this activity on a national basis.

The fact that present development of specialized technique does not always demand the use of specialists should not hold back the assignment of specialists to field control. The need exists for more intensive thinking and planning for all phases of this work. If able men are assigned to fire control jobs, the art will develop rapidly. It cannot develop until men of this type are given the opportunity to work on these problems to the exclusion of other pressing jobs.

Research in fire control is urgently needed to provide better basic information for the foundation of fire control work. The research men assigned to this work are few in number and their attempts to specialize in any one phase of the problem frequently meet with disfavor. If they spend their time on one fundamental problem, there is pressure to study something more practical, and this pressure often results in the disruption of long-time research projects urgently needed to establish our scientific footings. Research men in this field number scarcely a dozen workers, many too few to adequately approach this pioneering field.

If forestry had developed first in America, fire control would now be recognized as a major branch of forestry. A science of fire control would have developed, along with recognized highly developed techniques of attacking fire problems. In this country there is now developing a science of fire control. Growth must be rather slow; however, foresters can foster or retard this growth by their attitude toward the problem. If men in the profession recognize fire control work as a permanent pressing problem, and as a real part of professional forestry work, it can and should be organized on an adequate basis. The sooner fire control is thought of in this light, the sooner will knowledge and success in this field increase. Foresters should work toward a situation in which young men entering the profession with bent for fire control work may see a career ahead of them—a career offering opportunities comparable to those of other recognized fields.

HIGH AND LOW FIRE CONTROL COSTS BY REGIONS

M. R. Scott

Cost Accountant, Forest Service, Washington, D. C.

These high and low costs were determined by reference to totals per acre for prevention and presuppression for National Forests within each Region. The costs are per gross acre and are given in cents to the nearest mill.

	Prevention			Presuppression			Suppression			Total Costs		
	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost
Fiscal Year 1934												
Region 1												
Clearwater	0.001	0.007	0.008	0.023	0.073	0.096	0.003	0.001	0.004	0.026	0.082	0.108
Beaverhead	.000	.001	.001	.001	.001	.002	.001	.000	.001	.002	.002	.004
Region 2												
Black Hills	.006	.032	.038	.032	.126	.158	.007	.015	.022	.045	.173	.217
Gunnison	.000	.000	.000	.000	.001	.001	.001	.000	.001	.001	.001	.003
Region 3												
Coronado	.000	.000	.000	.008	.019	.027	.003	.000	.003	.012	.019	.031
Cibola	.000	.000	.000	.001	.002	.004	.001	.000	.001	.002	.003	.005
Region 4												
Payette	.000	.000	.000	.006	.026	.032	.005	.008	.013	.011	.035	.046
Humboldt	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Angeles	.025	.069	.094	.046	.246	.292	.012	.037	.049	.082	.352	.434
Mono	.000	.001	.001	.000	.001	.001	.001	.000	.001	.001	.002	.003
Region 6												
Mt. Hood	.002	.017	.019	.026	.073	.098	.002	.002	.004	.030	.091	.121
Wallowa	.000	.001	.001	.008	.009	.018	.003	.001	.003	.011	.011	.022
Region 7												
Allegheny	.034	.074	.107	.005	.069	.075	.006	.008	.014	.045	.151	.196
White Mt.	.003	.006	.009	.005	.010	.015	.002	.001	.003	.009	.018	.027
Region 8												
Cherokee	.003	.019	.022	.018	.112	.130	.010	.012	.022	.031	.143	.174
De Soto	.000	.001	.002	.005	.005	.010	.007	.013	.020	.012	.019	.032
Region 9												
Chippewa	.004	.069	.072	.035	.049	.084	.081	.069	.150	.120	.187	.307
Illinois	.004	.000	.004	.002	.001	.003	.013	.006	.019	.019	.007	.026
Fiscal Year 1935												
Region 1												
Kaniksu	.037	.062	.099	.029	.070	.098	.065	.061	.126	.131	.193	.324
Absaroka	.001	.001	.001	.000	.001	.001	.000	.000	.000	.001	.002	.003
Region 2												
Harney	.060	.199	.259	.011	.031	.042	.004	.009	.013	.075	.239	.314
Shoshone	.000	.000	.000	.001	.001	.002	.001	.000	.001	.002	.002	.003
Region 3												

Coconino	.000	.000	.000	.010	.024	.034	.004	.000	.004	.014	.024	.038
Carson	.000	.000	.000	.001	.002	.003	.001	.000	.001	.002	.003	.004
Region 4												
Boise	.005	.006	.011	.024	.022	.046	.029	.002	.032	.058	.030	.088
Nevada	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Angeles	.042	.057	.099	.056	.318	.374	.032	.022	.054	.130	.397	.527
Mono	.001	.001	.002	.000	.001	.002	.001	.000	.001	.002	.002	.005
Region 6												
Mt. Hood	.004	.018	.021	.035	.071	.106	.012	.006	.018	.051	.094	.145
Wallowa	.001	.002	.003	.008	.011	.020	.005	.005	.010	.015	.018	.033
Region 7												
Allegheny	.011	.169	.180	.009	.190	.199	.014	.010	.024	.034	.369	.403
Mtn. Lake	.000	.000	.000	.001	.000	.001	.000	.000	.000	.001	.000	.001
Region 8												
Choetawhatchee	.001	.001	.002	.034	.196	.230	.004	.004	.008	.040	.201	.241
Uharie	.000	.000	.000	.002	.004	.007	000	.000	.000	.002	.005	.007
Region 9												
Gardner	.005	.029	.034	.027	.113	.139	.008	.069	.077	.040	.211	.251
Superior	.001	.006	.007	.011	.008	.019	.001	.001	.002	.014	.015	.028

Fiscal Year 1936

Region 1												
Kaniksu	.003	.056	.059	.065	.091	.156	.004	.002	.006	.072	.150	.221
Beaverhead	.002	.001	.003	.002	.002	.004	.002	.000	.002	.007	.003	.010
Region 2												
Harney	.006	.016	.022	.016	.042	.058	.007	.009	.015	.029	.067	.095
Grand Mesa	.000	.000	.000	.001	.001	.002	.000	.000	.000	.001	.002	.003
Region 3												
Coronado	.001	.001	.002	.010	.029	.039	.009	.001	.010	.020	.031	.051
Carson	.000	.001	.001	.001	.003	.004	.001	.000	.001	.002	.003	.006
Region 4												
Boise	.005	.004	.009	.015	.039	.054	.006	.003	.009	.025	.047	.072
Nevada	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Cleveland	.059	.095	.154	.083	.223	.305	.007	.007	014	148	325	473
Inyo	.001	.002	.003	.001	.001	.002	.000	.000	.000	.002	.002	.005
Region 6												
Columbia	.002	.011	.014	.031	.108	.138	.004	.004	.007	.037	.123	.159
Wallowa	.001	.003	.004	.013	.016	.029	.005	.003	.008	.019	.022	.041
Region 7												
Cumberland	.026	.064	.091	.082	.198	.280	.018	.041	.059	.126	.303	.430
White Mt.	.006	.013	.019	.012	.025	.037	.001	.001	.002	.019	.039	.058
Region 8												
Nantahala	.005	.019	.024	.036	.159	.195	.005	.005	.011	.047	.184	.230
Uharie	.001	.003	.004	.014	.028	.042	.003	.003	.005	.017	.034	.052
Region 9												
Shawnee	.006	.012	.018	.050	.110	.161	.009	.018	.027	.065	.141	.206
Wayne	.002	.012	.015	.005	.002	.007	.001	.001	.001	.008	.015	.023

EXPENDITURES FOR FIRE PREVENTION AND PRESUPPRESSION ON NATIONAL FORESTS

Division of Fire Control

Washington, D. C.

The following table shows fire control expenditures per acre for prevention and presuppression only. The acreage used is gross area inside national forest boundaries for Western Regions. For Eastern regions "protection areas" are used. This excludes from the acreages of Eastern regions those portions of purchase areas on which protection has not been organized. All acreages used are those in effect for calendar year 1937.

These expenditure figures do not include anything for suppression, nor do they include cost adjustments (CCC enrollees and similar labor, depreciation and maintenance of improvements) for prevention or presuppression.

By comparing the first and last columns for each region one can readily see the increases for FY 1938 (beginning July 1, 1937) over FY 1936. By comparing the different rates in the last column one can see the differences in planned FY 1938 expenditures for prevention and presuppression.

Region	FY 1936 expenditures for prevention + presuppression ÷ 1937 protection	Increase per acre for FY 1937	Increase per acre for FY 1938	Total per acre for FY 1938
1	$ .0300	$ .0072	$ .0013	$ .0385
2	.0030	.0005	.00003	.0035
3	.0046	.0004	.0001	.0051
4	.0066	.0026	.0003	.0095
5	.0335	.0054	.0013	.0405
6	.0235	.0047	.0012	.0294
7	.0314	.0011	.0007	.0332
8	.0244	.0016	.0015	.0275
9	.0338	.0015	.0013	.0366
10	.0005	....	.00001	.0005
Total	$ .0173	$ .0029	$ .0007	$ .0209

SPECIAL ISSUES OF FIRE CONTROL NOTES FOR COOPERATORS

Region 6

Forest Service

Can Fire Control Notes be made worthwhile to the army of cooperators on which the success of fire control so largely depends? Region 6 believes it can and proposes a definite plan. A "Cooperators' Issue" for August is not possible, but in February such an issue could be put out for cooperators in Eastern States followed by a May or June, 1938, issue for Western States. Are State, Forest Service and other agencies interested? Will they agree to collect the necessary material—particularly from cooperators themselves?

It seems that Fire Control Notes could be used very effectively in stimulating interest on the part of certain classes of cooperators. Operators of saw mills, logging camps, contractors engaged in highway and other construction work, and key men in the various communities would, without doubt, really appreciate receiving the publication. In order to make the Notes of greatest value to this group more articles pertaining to fire prevention, suppression, and slash disposal on industrial operations should be included.

Fire Control Notes is probably a little too technical to have a very strong appeal to the great majority of local rancher-cooperators, who are usually interested chiefly in things with which they are familiar and which touch upon their own interests. In order to make the publication of maximum appeal to this class, the editorial policy would have to be modified to include a good sprinkling of items and articles which could be readily grasped and tied into their activities and experiences. Of course, it should not be difficult to do this two or three times a year but it might become difficult to accomplish in every issue. My idea is that an occasional "cooperators' issue" might be published to be sent to these people.

It is probably too late to prepare a special cooperators' issue for July, desirable as it might be to do so. However, if one could be prepared for issue early in August, it should have a highly useful effect in bolstering interest and action during the more critical period of the coming fire season. If this can be done, and it is hoped it can, Region 6 would like at least 1,000 extra copies of the publication. Limiting the circulation to certain of the forests which have taken the lead in cooperative effort would make it possible to determine the value of continuing and extending the idea.

FIRE DISPATCHING AND THE DISPATCHER

C. B. Sutliff

Fire Inspector, Region 1

The author believes that Fire Dispatching is probably the most vitally important single phase of the entire fire control organization and that the Dispatcher's position has that importance in relation to others in the fire control organization. Dispatching is important, and though some may differ as to the degree, it is stimulating to have presentations of this kind.

The degree of responsibility resting with each dispatcher position depends upon (1) the magnitude of the fire control problem presented, and (2) the protection organization and suppression force resources afforded by the individual protection unit or area concerned. If the fire problem presented and protection resources afforded are such that an unlimited suppression force can be dispatched to each fire as it is detected, the job of fire dispatching is a very simple procedure. Few protection units or forested areas are so endowed at present and for various obvious reasons it is very unlikely that a great many of them ever will be, which indicates the necessity for providing the dispatcher with all the implements of fire dispatching, including every possible source of pertinent information. Here it becomes clear that there still remains considerably more to be learned about fire behavior and the methods of obtaining adequate dispatching information than has been discovered to date.

The fire dispatcher as referred to in this discussion is any individual upon whom rests the responsibility of making the decisions in manipulating and directing fire control forces and effort within a given unit of area. When confronted with the more complex problems involved in fire dispatching, of which there are many, his decisions at times are momentous.

What is the main problem which immediately confronts the dispatcher when a fire is reported? It is that of calculating the probabilities of the fire and determining the size of suppression force necessary to control it within a certain time objective. In dealing with this problem he is concerned with three separate questions: (1) What will be the rate of spread? (2) What will be the resistance to control? (3) What will be the rate of held line output by the attacking force? Several influencing factors must be given careful consideration in each case if the correct answers are to be determined.

1. *Rate of spread*—What are the more important factors which govern rate of spread? These can be boiled down to four, each of which is comprised of from one or two to several important subdivisions. From a phys-

ical standpoint these factors are equally divided into classes, constants and variables.

CONSTANTS	VARIABLES
1. *Fuels*	1. *Wind*
a. Continuity	a. Velocity
b. Size	b. Direction
c. Volume	c. Duration
d. Arrangement	2. *Fuel moisture content*
2. *Topography*	a. Fine fuels and vegetation
a. Slope	b. Medium fuels, ½" to 2" dia.
b. Exposure (synonymous with fuel moisture)	c. Large fuels, over 2" dia.
	d. Humidity (existing)
	e. Precipitation (previous)

Subdivisions (d) and (e) under fuel moisture content are simply an aid to determining fuel moisture content itself. Neither has a direct influence upon rate of spread except as each affects the immediate moisture content of the fuels concerned.

Fuels obviously influence rate of spread to a greater extent than any other single factor. Without them there can be no fire; yet, in certain natural fuel combinations, a fire may spread rapidly with little or no influence from any of the three remaining factors other than that afforded by average summer weather conditions.

Wind is the second most important factor which influences rate of spread. Examination of weather records for days upon which disastrous fires have occurred indicates that wind is more influential than any of the remaining factors. With severe wind conditions, rapid spread has been known to occur, even with greatly reduced fuel influence and fairly high fuel moisture content.

Fuel moisture content is perhaps the third most important factor, with topography last, though by no means unimportant. Topographic influence (steepness of slope) acts in the same manner and has the same effect up to a certain point as wind. Exposure has nothing more to do with rate of spread than the effect it has on fuel moisture content.

2. *Resistance to control*—The answer to the question about resistance to control is governed pretty much by two constant factors which in turn are comprised of several sub-factors.

1. *Fuels*
   a. Character or kind
   b. Size
   c. Volume or density

2. *Topography*
   a. Soil conditions
   b. Steepness of slope

Some fire control men are inclined to consider heat from a going fire as a factor in resistance to control. This involves rather a hair-line distinction

as to where rate of spread leaves off and resistance to control begins. Obviously a fire which is spreading at a rapid rate will be difficult, if not impossible, to work against anywhere near its head. It is felt, for this reason, that if rate of spread is properly calculated, appropriate allowance will have been made for the heat resistance factor at the time of calculating probable final perimeter and job size.

3. *Rate of held line output*—What governs the rate of held line production? Resistance to control is one of the main factors. The others are directly concerned with the type of suppression force employed. Several factors and sub-factors are involved:

1. *Size of crew*
   a. No. men
   b. No. overhead
2. *Character of crew and O. H.*
   a. Experience
   b. Training
   c. Adaptability
3. *Fatigue* (effect of this factor varies with type of men employed)
   a. Length of work period

The calculation of probabilities thus far appears to be a somewhat complicated task involving innumerable intricacies. In addition to the consideration which must be given each of the factors mentioned, there also remain four others which must come into the picture. They represent the various time elements and method of attack to be employed.

1. *Discovery time*
   a. Actual
2. *Arrival time*
   a. Estimated (time of arrival of sufficient force to deter spread as calculated)
3. *Corral time*
   a. Objective
4. *Metrod of attack*
   a. Frontal
   b. Flanking

With but little study of the several factors indicated, the possibility can be seen of innumerable combinations, each of which would produce a different fire suppression job. Such circumstances make the present day fire dispatcher's job most complicated and difficult, if not impossible.

What is the answer to the dispatching phase of the fire control problem; that is, how can the probabilities of each fire be calculated immediately following discovery with a degree of accuracy productive of a thoroughly sound basis for adequate but not extravagant suppression action? Opinion seems to be divided along three lines of thought:

(1) There are those who are confident that the developing of super intelligent dispatchers, men who will be capable of dispatching by relying chiefly upon judgment and past experience, is entirely within the realm of possibilities.

(2) Some feel that not until such time as the art of dispatching has been

reduced to a simple process of reading a few mechanical recording gadgets, referring to a chart or two and doing a few simple calculations with pencil or aid of an automatic slide rule—all of which may be done without background or previous experience—will all obstacles have been surmounted and the problem solved.

(3) Others believe that perhaps a combination of a little sound judgment gained through a reasonable amount of training and experience, and a few basically sound mechanical devices developed from such data as are available and with provisions for amending and maintaining them abreast of developments as further knowledge is gained, is probably the most logical immediate solution to the problem.

Consider the first of the three solutions advanced: Is there any reason to believe that there is greater probability of developing super-intelligent dispatchers in the immediate future than have been developed in the past? Most likely not as much. Even though it may be possible, is it practical when compared to alternative methods already in various stages of development?

The second solution advanced leans toward the opposite extreme. Considering such obvious prerequisites as the vast amount of research, study, development work, etc., which must be accomplished, the advent of such devices can readily be seen to exist only in the distant future, if at all. Granting the possibility of developing such a dispatching scheme, there again arises the question, "Is it practical?"

In the meantime fires occur and fire dispatching must go on. After studying the various opinions advanced and the possibilities afforded, the logical course to pursue would seem to be along the lines advanced by the third scheme, which is a course midway between the two extremes. Region 1 has developed to this end a set of guide charts containing the best data available at present which are used by fire dispatchers as guides when calculating probabilities. The charts will be amended to make full use of more and better basic data as rapidly as such data become available.

The rate of spread data used in compiling the charts was obtained, for the most part, from analyses of records of past fires. The rate of held line output data was obtained from both records of past performance and from answers to questionnaires by carefully selected men of experience.

The Region 1 dispatcher guide charts comprise the four items shown.

Item One is the rate of spread danger meter from which spread danger classes are obtained. This meter employs all of the factors which influence rate of spread that are used in the Region 1 Forest Fire Danger Meter

developed by the Northern Rocky Mountain Forest and Range Experiment Station, and now used extensively throughout the Region. In addition, it gives consideration to steepness of slope.

Item Two contains two charts. Chart one provides the perimeter increase or spread rate factors for the four recognized fuel types according to the various spread danger classes. The spread rate factors indicated represent approximate perimeters at the end of the first hour of free burning after discovery. Chart two contains the time factors and the corresponding multipliers to be used to determine the probable perimeter of a free burning fire for any given period of time within the first burning period after discovery. These factors were obtained by working out, according to formulae, the probable perimeter of a fire for each of the many time factor combinations. They take into account accelerated spread according to time of day.

Item Three is a guide chart for determining manpower needs to accomplish a given job of held line construction within an established time objective. The factors influencing rate of output (except fuel resistance) have been accounted for in the unit output figures shown. The figures at the extreme right represent percentage of efficiency according to number of hours of continuous work. The figures at the bottom represent the percentage of efficiency according to size of crew employed. The figures also take into account the probable character of crew to be employed.

Item Four is an instruction card pertaining to the use of the guide charts. It is also a tickler list of the various factors to which consideration must be given regardless of method of calculating probabilities employed.

At the time the charts were compiled the fact was both known and accepted that they were far from being infallible and that there were many "bugs" yet to be found and corrected. The charts were offered for use throughout the 1936 fire season and the results were more encouraging than had been anticipated. Wherever possible, checks were made upon their accuracy. It is yet much too soon to draw any definite conclusions, but the results clearly indicate the superiority of this chart system to offhand judgment fire dispatching. Whether the charts should remain in their present form is questionable. Undoubtedly, there is some need for simplification, but until such time as the pertinent data contained have been thoroughly checked for accuracy and adjusted to meet acceptable standards, the problem of final arrangement should remain secondary in importance.

The greatest handicap which confronted many of the dispatchers when endeavoring to make use of the guide charts was the lack of facilities for

obtaining accurate information regarding weather and fuel conditions at the time and for the immediate area concerned in each fire. Such information must be available if the charts are to serve the purposes for which they are intended. The lack of facilities for obtaining such data cannot be considered as a weakness in the charts. Whether this or any other method of calculating probabilities be employed, weather and fuel conditions at the time of discovery and for the vicinity of the fire must be known.

The charts are still in a stage of experimental development, and no attempt has been made to cover in detail in this manuscript the methods involved in their construction. Doing so at this time is not warranted because a few changes are now pending and it is quite probable many others will be made before a state of perfection is reached. The present charts are being offered not as finished products but as a possible source of information for others having similar problems.

Conditions at Location of Fire	1						
	2						
	Moisture Content of Fuels $\frac{1}{2}$" and Less						
WIND	Over 25%	19-25%	14-18%	11-13%	8-10%	5-7%	Under 5%
0-3 MPH	2	3	4	4.5	5	5.4	5.7
4-7 MPH	3	3	4	4.5	5.4	5.7	6.3
8-12 MPH	3	4	4.5	5	5.7	6.3	6.8
13-18 MPH	4	4	5	5.4	6	6.6	7
19-24 MPH	4	4.5	5	5.7	6.3	6.8	7.2
Over 24 "	4.5	5	5.4	6	6.6	7	7.4
	Spread Danger Class						

RATE OF SPREAD DANGER METER

Season and Slope Indicator (2)

ITEM ONE

Conditions at Location of Fire	Moisture Content of Fuels $\frac{1}{2}$" and Less						
WIND	Over 25%	19-25%	14-18%	11-13%	8-10%	5-7%	Under 5%
0-3 MPH							
4-7 MPH							
8-12 MPH							
13-18 MPH							
19-24 MPH							
Over 24"							
	Spread Danger Class						

RATE OF SPREAD DANGER METER

Season and Slope Indicator O

FRONT

						1
						2
						3
2	2	2	3	4	4.5	3
2	2	3	4	4.5	5	5.4
2	3	4	4.5	5	5.4	5.7
3	3	4	4.5	5.4	5.7	6.3
3	4	4.5	5	5.7	6.3	6.8
4	4	5	5.4	6	6.6	7
4	4.5	5	5.7	6.3	6.8	7.2
4.5	5	5.4	6	6.6	7	7.4
5	5.4	5.7	6.3	6.8	7.4	7.5

(P)

(1)

(2)

(3)

SLIDE

INSTRUCTIONS

1. Pre & Post-Season - Set slide at (P) for fires before July 6 or after Sept. 10 if slope and exposure are normal.

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2. Mid-season - Set slide at (1) for fires during period July 6 to Sept. 10 if slope and exposure are normal.

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3. Slope and Exposure - If slope is long, steep and exposed to prevailing wind, set slide as follows:

Slope	Season	Indicator
35-60%	Pre & Post	(1)
Over 60%	Pre & Post	(2)
35-60%	Mid-season	(2)
Over 60%	Mid-season	(3)

------

4. Relative Humidity - If below 15%, read next fuel moisture content class to right. If already under 5%, read next higher wind-velocity class.

5. General - Weather conditions should be determined as accurately as possible at the time and for the vicinity where fire is located.

BACK

ITEM TWO

Region One — Western Forests

DISPATCHER'S GUIDE CHARTS - PERIMETER-INCREASE DATA

NOTE: Chart data assumes free burning conditions, therefore corral period perimeter increases indicated must be adjusted according to strength and method of attack in each case, if begun during first period.

Chart One

Spread Danger Class	Fuel Type: Low	Med.	High	Ext.
	Perim. Incr. Factor (First-Hour Perimeter)			
2	.04	.08	.16	.2
3	.08	.2	.32	.6
4	.6	.8	1.0	1.8
4.5	1.0	1.2	1.6	2.8
5	1.6	2.0	2.8	4.8
5.4	2.6	3.8	5.0	8.1
5.7	3.7	5.8	7.5	12.
6	5.6	8.4	11.	17.
6.3	8.2	12.	16.	25.
6.6	11.	15.	20.	33.
6.8	12.	18.	23.	39.
7	14.	20.	26.	46.
7.2	16.	23.	30.	51.
7.4	17.	25.	33.	56.
7.5	18.	26.	35.	59.

Chart Two

Time of Discovery	Time Objectives: 1st Per'd	12 p.m.	11 p.m.	10 p.m.	9 p.m.	8 p.m.	7 p.m.	6 p.m.	5 p.m.	4 p.m.	3 p.m.	2 p.m.	1 p.m.	12 noon	11 a.m.	10 a.m.
	Perimeter-Increase Factor Multipliers - According to Time Objectives Used															
9 a.m.	82	78	75	70	63	56	49	42	35	28	21	15	10	6	3	1
10 a.m.	75	72	69	63	56	49	42	35	28	21	15	10	6	3	1	
11 a.m.	68	65	61	56	49	42	35	28	21	15	10	6	3	1		
12 noon	61	58	54	49	42	35	28	21	15	10	6	3	1			
1 p.m.	49	47	44	39	33	27	21	15	10	6	3	1				
2 p.m.	39	37	34	30	25	20	15	10	6	3	1					
3 p.m.	29	27	25	22	18	14	10	6	3	1						
4 p.m.	21	19	17	14	12	9	6	3	1							
5 p.m.	18	16	14	12	9	6	3	1								
6 p.m.	15	13	11	9	6	3	1									
7 p.m.	12	10	8	6	3	1										
8 p.m.	8	7	5	3	1											

Night Fires: For discoveries between 5 a.m. and 9 a.m. increase the discovery hour by the required number of hours to advance it to 9 a.m. Then advance both the estimated arrival time and the corral objective the same number of hours and work out probabilities on the basis of a 9 a.m. discovery. Example: 6 a.m. discovery, 8 a.m. arrival and 10 a.m. corral would be worked thus - 9 a.m. discovery, 11 a.m. arrival and 1 p.m. corral.

For all other night fires (between 9 p.m. and 5 a.m.) simply reverse a.m. hours to p.m.'s and p.m. hours to a.m.'s and use charts direct as for a daytime discovery. Example: 11 p.m. discovery, 1 a.m. arrival and 6 a.m. corral would be worked out as an 11 a.m. discovery, 1 p.m. arrival, and 6 p.m. corral. Remember - the danger class used must represent night conditions at site of fire.

(The data contained herein is intended for use as a guide for dispatching.)

ITEM THREE

DISPATCHER'S GUIDE CHARTS ~ CORRAL-LINE OUTPUT DATA

SMOKECHASER OUTPUT FIGURES BASED UPON ESTIMATES OF APPROXIMATELY 150 EXPERIENCED MEN, 1000 ESTIMATES TAKEN IN 1930 AND 600 IN 1935 AND 1936.
OUTPUT = EXTREME, .25 CH.; HIGH, .8 CH.; MEDIUM, 2.0 CH.; LOW 3.3 CH.

HOURS OF WORK	SMOKECHASER UNITS OF OUTPUT ACCORDING TO SIZE OF CREW EMPLOYED AND NUMBER HOURS WORKED — NUMBER OF MEN																		FATIGUE FACTOR APPLICABLE ACCORDING TO NUMBER HOURS WORKED
	1	2	3	4	5	7	10	15	20	25	30	40	50	75	100	125	150	175	200	
1	1.00	2.00	3.00	4.00	4.95	6.86	9.50	12.7	14.0	15.0	15.9	19.2	28.5	30.0	35.0	40.6	45.0	48.1	50.0	100
2	2.00	4.00	6.00	8.00	9.90	13.7	19.0	25.5	28.0	30.0	31.8	38.4	45.0	60.0	70.0	81.3	90.0	96.3	100.	100
3	2.97	5.94	8.91	11.9	14.7	20.4	28.2	37.9	41.6	44.6	47.2	57.0	66.8	89.1	103.	121.	133.	143.	149.	97
4	3.82	7.64	11.5	15.3	18.9	26.2	36.3	48.7	53.5	57.3	60.7	73.3	86.0	115.	134.	155.	172.	184.	191.	85
5	4.51	9.02	13.5	18.0	22.3	30.9	42.8	57.5	63.1	67.7	71.7	86.6	101.	135.	158.	183.	203.	217.	225.	69
6	5.06	10.01	15.2	20.2	25.0	34.7	48.1	64.5	70.8	75.9	80.5	97.1	114.	152.	177.	205.	228.	243.	253.	55
7	5.52	11.0	16.5	22.1	27.3	37.9	52.4	70.4	77.3	82.8	87.8	106.	124.	166.	193.	224.	248.	266.	276.	46
8	5.92	11.8	17.8	23.7	29.3	40.6	56.2	75.5	82.9	88.8	94.1	114.	133.	178.	207.	241.	266.	285.	296.	40
9	6.27	12.5	18.8	25.1	31.0	43.0	59.5	79.9	87.7	94.0	99.7	120.	141.	188.	219.	255.	282.	301.	313.	35
10	6.60	13.2	19.6	26.4	32.7	45.3	62.7	84.1	92.4	99.0	105.	127.	149.	198.	231.	268.	297.	318.	330.	33
11	6.91	13.8	20.7	27.6	34.1	47.4	65.6	88.1	96.7	104.	110.	133.	155.	207.	242.	281.	311.	333.	345.	31
12	7.21	14.4	21.6	28.8	35.7	49.5	68.5	91.9	101.	108.	115.	138.	162.	216.	252.	293.	324.	347.	361.	30
13	7.50	15.0	22.5	30.0	37.1	51.4	71.2	95.6	105.	113.	119.	144.	169.	225.	263.	305.	337.	361.	375.	29
14	7.78	15.6	23.3	31.1	38.5	53.4	73.9	99.2	109.	117.	124.	149.	175.	233.	272.	316.	350.	374.	389.	28
15	8.05	16.1	24.1	32.2	39.9	55.2	76.5	103.	113.	121.	128.	155.	181.	241.	282.	327.	362.	387.	403.	27
16	8.31	16.6	24.9	33.2	41.1	57.0	78.9	106.	116.	125.	132.	159.	187.	249.	291.	338.	374.	400.	415.	26
17	8.56	17.1	25.7	34.2	42.4	58.7	81.3	109.	120.	128.	136.	164.	193.	257.	300.	348.	385.	412.	428.	25
18	8.80	17.6	26.4	35.2	43.6	60.3	83.6	112.	123.	132.	140.	169.	198.	264.	308.	357.	396.	423.	440.	24
19	9.03	18.0	27.0	36.1	44.7	61.9	85.8	115.	126.	135.	144.	173.	203.	271.	316.	367.	406.	435.	451.	23
20	9.25	18.5	27.7	37.0	45.8	63.4	87.9	118.	129.	139.	147.	178.	208.	277.	324.	376.	416.	445.	463.	22
	100	100	100	100	99	98	95	85	70	60	53	48	45	40	35	32.5	30	27.5	25	← SIZE OF CREW FACTOR

OUTPUT FIGURES SHOWN ARE BASED UPON DAYLIGHT WORK. OVERHEAD HAS BEEN ASSUMED TO CONSIST OF ONE QUALIFIED FOREMAN AND THREE QUALIFIED STRAWBOSSES PER 25-MAN UNIT WITH CORRESPONDING NUMBER OF FIRE OR SECTOR FOREMEN, FOREST OFFICERS, ETC. THIS DATA FOR USE AS A GUIDE.
(DIVIDE CHAINS OF WORK BY SC OUTPUT RATE BEFORE USING THIS CHART TO GET MAN POWER.)

ITEM FOUR

INSTRUCTIONS FOR USING REGION ONE DISPATCHER GUIDE CHARTS – WESTERN FORESTS

A. FACTORS THAT MUST BE CAREFULLY CONSIDERED IN ANY METHOD OF CALCULATING FIRE PROBABILITIES OR DETERMINING MAN-POWER NEEDS. THE INFLUENCE OF THESE FACTORS HAS BEEN GIVEN CONSIDERATION IN THE REGION ONE CHARTS, INSOFAR AS POSSIBLE TO DETERMINE FROM THE LIMITED AMOUNT OF DATA AVAILABLE:

1. FUELS:
   - A. CONTINUITY
   - B. SIZE
   - C. VOLUME
   - D. ARRANGEMENT
2. TOPOGRAPHY:
   - A. SLOPE
   - B. EXPOSURE
3. WIND:
   - A. VELOCITY
   - B. DIRECTION
   - C. DURATION
4. FUEL MOISTURE:
   - A. HUMIDITY (EXISTING)
   - B. 1/4" AND LESS FUELS
   - C. PRECIPITATION (PREVIOUS)
   - D. LARGE FUELS (2" PLUS)
5. SIZE OF CREW:
   - A. NO. OF MEN (LOSSES THROUGH PLACEMENT AND SUPERVISION).
6. CHARACTER OF CREW AND OVERHEAD:
   - A. EXPERIENCE
   - B. TRAINING
   - C. ADAPTABILITY
7. FUEL RESISTENCE:
   - A. SAME AS 1–A,B,C,D EXCEPT AS EACH AFFECTS HELD-LINE OUTPUT
8. FATIGUE:
   - A. LENGTH OF WORK PERIOD (VARIES GREATLY WITH TYPE OF MEN USED).
9. DISCOVERY TIME:
   - A. ACTUAL
10. ARRIVAL TIME:
    - A. ESTIMATED (SUFFICIENT FORCE TO DETER SPREAD AS CALCULATED).
11. CORRAL TIME:
    - A. OBJECTIVE (ESTABLISHED ARBITRARILY).
12. METHOD OF ATTACK:
    - A. FRONTAL
    - B. FLANKING

B. SUGGESTED METHODS OF OBTAINING TIMELY MEASUREMENTS OF FACTOR INFLUENCE

1. THROUGH OBSERVING AGENCIES: LOOKOUTS, SMOKECHASERS, CREWMEN – GLASSES OR TELESCOPE MAY BE USED.
2. INTIMATE PERSONAL KNOWLEDGE OF DISPATCHER OR OTHER PERSONS IMMEDIATELY AVAILABLE.
3. NEAREST INFLAMMABILITY STATIONS: WIND GAUGES, PSYCHROMETER LOCATIONS, ETC. SEVERAL READINGS DAILY.
4. FUEL TYPE MAP: FOR GENERAL INFORMATION AND TO BE RELIED UPON WHEN 1 & 2 FAIL TO SERVE NEED.
5. CURRENT WEATHER RECORDS: FUEL MOISTURE, WIND, HUMIDITY, RAINFALL, ETC., AS RECORDED SEVERAL TIMES DAILY.

C. CALCULATING PROBABILITIES WITH REGION ONE GUIDE CHARTS

1. ASCERTAIN DANGER CLASS FROM SPREAD DANGER METER. ADJUST ACTUAL MEASUREMENTS, SECURED FROM SOURCES NEAREST TO FIRE, BY CAREFULLY COMPARING SLOPE, EXPOSURE, TIMBER STAND (DENSE, AVERAGE OR OPEN), EXPOSURE TO WIND, ELEVATION, RAINFALL (RECENT AND PAST), TIME OF DAY, ETC.
2. ASCERTAIN RATE OF SPREAD FACTOR FROM CHART I. SELECT PROPER DANGER CLASS, IN FIRST COLUMN, THEN REFER TO PROPER RATE OF SPREAD (FUEL TYPE) COLUMN, ON SAME DANGER CLASS LINE, AND RATE OF SPREAD FACTOR WILL BE INDICATED. DETERMINE PROPER RATE OF SPREAD (FUEL TYPE) BY METHODS SUGGESTED UNDER B 1, 2 & 4 ABOVE.
3. ASCERTAIN PERIMETER INCREASE FACTORS FROM CHART II. IN FIRST COLUMN SELECT TIME OF DISCOVERY OF FIRE (TO NEAREST PRECEDING HOUR), THENCE ACROSS CHART TO PROPER ARRIVAL TIME AND CORRAL TIME COLUMNS. THEREUNDER WILL BE INDICATED THE PROPER MULTIPLIERS TO BE USED IN DETERMINING THE PROBABLE FREE BURNING PERIMETERS FROM DISCOVERY TO ARRIVAL AND FROM DISCOVERY TO CORRAL TIME. THE PERCENTAGE OF THE DIFFERENCE BETWEEN THE ARRIVAL TIME PERIMETER AND CORRAL TIME PERIMETER WHICH SHOULD BE ALLOWED DEPENDS ENTIRELY UPON STRENGTH OF ATTACKING FORCE AND THE METHOD OF ATTACK ANTICIPATED. THE ARRIVAL TIME PERIMETER PLUS THE CORRAL PERIOD ALLOWANCE EQUALS TOTAL JOB SIZE ANTICIPATED.
4. ASCERTAIN MAN-POWER NEEDS FROM CHART III. DIVIDE TOTAL CHAINS OF ANTICIPATED PERIMETER BY THE SMOKECHASER OUTPUT RATE FOR THE FUEL TYPE CONCERNED. THIS GIVES THE NUMBER OF SMOKECHASER HOURS OF WORK TO BE DONE. IN FIRST COLUMN SELECT NUMBER OF HOURS CALCULATED IN CORRAL PERIOD, FOLLOW THIS LINE TO RIGHT UNTIL AN OUTPUT FIGURE EQUAL TO NUMBER OF HOURS OF SMOKECHASER WORK IS FOUND. AT TOP OF COLUMN WILL BE SHOWN NUMBER OF MEN REQUIRED TO DO THE JOB, WITH ALLOWANCE MADE FOR FACTORS A 5,6,7 AND 8, AS SET FORTH ABOVE.
5. NIGHT FIRES: BETWEEN 9 P.M. AND 5 A.M. CHART II MAY BE USED IN THE SAME MANNER AS FOR DAYTIME DISCOVERIES EXCEPT FOR MULTIPLIERS SHOWN IN COLUMN TWO. THESE ARE FOR DAYTIME DISCOVERIES ONLY AND ARE APPLICABLE WHEN A DISPATCHER DESIRES TO DETERMINE THE PROBABLE PERIMETER OF A FIRE WHICH HAS ESCAPED CORRALLING THROUGHOUT THE FIRST DAY – TO DETERMINE JOB SIZE FOR SECOND A.M. CORRALLING.
6. EXAMPLE: AUGUST 7, NORMAL SLOPES, NORMAL HUMIDITY, 4–5 MILE WIND, 9% FUEL MOISTURE –D.C. 5. FUEL TYPE IS MEDIUM SPREAD AND MEDIUM RESISTENCE; DISCOVERY TIME IS 10 A.M.; ARRIVAL TIME IS 12 NOON; CORRAL OBJECTIVE IS 2 P.M. CHART I GIVES A SPREAD FACTOR OF 2.0. CHART II GIVES AN ARRIVAL TIME MULTIPLIER OF 3 AND A CORRAL TIME MULTIPLIER OF 10. THUS PROBABLE PERIMETER ON ARRIVAL IS 2.0 X 3 OR 6 CHAINS. DISCOVERY TO CORRAL TIME PERIMETER IS 2.0 X 10 OR 20 CHAINS. 20 MINUS 6 IS 14 CHAINS OR FREE BURNING INCREASE DURING CORRAL PERIOD. IF FRONTAL ATTACK IS PLANNED 25% SHOULD BE SUFFICIENT ALLOWANCE. THUS 6 CHAINS PLUS 25% OF 14 CHAINS EQUALS 9.5 CHAINS OR PROBABLE TOTAL JOB SIZE.

TRACTOR TRAILS VS. HORSE TRAILS

C. S. Cowan

Chief Fire Warden, Washington Forest Fire Association

The timeliness of Mr. Cowan's article is emphasized by a coincidence. Without knowledge of this article, a similar proposal has been advanced for consideration in the Forest Service. Specific recommendations in that proposal were:

> Obtain a supply of high power, high speed trucks of three or five ton capacity.
>
> On each truck keep a crawler track trailer and a tractor equipped with brushbuster or other suitable rig, and a high speed auxiliary transmission (if desirable).
>
> Go in for *tractor* trails to supplement existing road systems. Clearing, but no excavation except when slopes exceed 30 per cent or so.
>
> Focus on plans and specifications which will put the tractor-brushbuster-trailer rigs at the fire as soon as a crew could get there by usual methods of transportation, the machine rigs to be used for line construction, use of foam or transportation of supplies, equipment or water as circumstances might dictate.

The problem of the pack horse country is a complicated one. The average pack horse is capable of taking a 175-pound load some 15 miles a day. Carrying a ton of supplies should therefore require a string of 13 to 14 horses. If the trip involves a distance in excess of one day's travel, complications begin, especially in the Coast country, where natural feed is simply nonexistent. Pack horses also must be provided to pack feed for the animals. The time taken in packing and unpacking and the necessity for the wrangler to have at least two saddle horses (one for his helper) also mean more trouble for the same results.

Horse trails must be kept to a grade which is below that of a foot trail for men. The straight line delineation is therefore out of consideration when locating horse trails. Pack horses are also getting scarce, and if a forest organization decides to own several strings, the animals must be fed and cared for the greater part of the year in times when as nonproducers they take but do not give.

The mechanical era has just begun and a way out of the pack horse business can be seen. And, if I am correct in my guess, foresters can greatly increase the efficiency and the radius in which mechanical aids can be utilized at a decrease in cost.

The tractor is already a known factor in fire control. The trend is now toward greater and bigger tractors. In forestry, this is *not* an advantage. Transportation becomes a problem, investments are heavy, and construction of "cat" trails for equipment such as a fifty, sixty-five or R D 8 means

falling of timber, building of heavy bridges and culverts and side sloping cuts, if the road is to be kept open.

But a light tractor of perhaps 10-15 horsepower, with a 36 to 40-inch blade, will cut trail of sufficient tread to enable such a tractor to pull a wheeled trailer hauling approximately 2,500 pounds weight with ease. Grades of 17 to 20 per cent can be utilized. Even fairly closely growing trees can be negotiated without trouble.

Such a tractor would be of tremendous assistance on the fire line, for it would build a trail wide enough for a backfire line, and it would be of much help in swamping. The tractor I suggest would therefore be of multiple use, and the honest application of this appellation should mean much to the budgeting authorities, who so coldly weigh dollars and cents against ideas, practical and unpractical alike. The tractor for transportation is a simple problem. I had occasion to establish a camp 12 miles back in the hills. Horses for the weights required to be moved became a problem, so the following method was tried:

The old horse trail was swamped out, making it possible to keep a straighter, albeit steeper, trail for some 9 miles to an elevation of 2,860 feet. This was done with nine men in six days. In two days, a 15-cat had swamped out the logs which had but a single saw cut in them, pulled logs out of the trail and reached the end of the swamped road in 3 days, plus trailer and 2,600 pounds of grub, tentage, gasoline and oil, men's dunnage, wire rope, bolts and nuts, cement, and cooking utensils—a mess of articles which would have caused any self-respecting horse wrangler to say at least, "Oh, dear." You know how horse "ski-men" are when sorting articles into pack loads.

The trailer consisted of front axle and wheels of a light car, with the steering arms welded so that the wheels were locked, a 4 x 4-inch wood sill mounted the axle, two pieces of strap iron 3½ inches by ½ inch to form a triangular coupling to the tractor and a box mounted at three points, two on the axle and one at the front, bolted so that it could be readily removed. Total cost $13. It was not the best sort of trailer, but it did the work and proved our ideas. We know now what can be done with this method. We would greatly desire a bulldozer of the type suggested on a small tractor, as we believe that with such an outfit, a six-man crew for emergency tractor trail work (to take the place of the old horse trail), would be a most efficient unit. Costs, of course, must be considered. A light 10-15 horsepower tractor costs about one-quarter that of a 60. A 60 can be in one place only at one time. Four light tractors can be in four places at one time.

The 10-15 is a more efficient unit than a 60 for the type of work under consideration. It is also much more efficient for general forest work than 24 head of horses. The initial costs are about the same, the number of men required to feed the horses, take care of them and house them as compared with the number to care for the tractor is much in favor of the tractor. Such a tractor would also be invaluable in maintaining and grading the many miles of truck trails constructed during the past four years by the CCC.

Not the least consideration is that of primary transportation. A light tractor can be transported on a 1½-ton truck on truck trails. The transportation of a 60 tractor presents many problems, especially on country roads and county bridges. The small trail building tractor is a possibility no forest protection agency can afford to overlook.

Lacquer for Lookout Maps—In seeking a lacquer that would meet the requirements of a good coating for lookout maps, the best solution we have found is DuPont Paper Lacquer No. 395 and DuPont Thinner No. 3991. This lacquer is waterproof and transparent at any thickness desired. It should be mixed in the ratio of 3 parts of thinner to 2 parts of lacquer, and the best results are obtained by applying 3 thin coats with a brush, the second and third coats tending to make the surface smoother and more transparent. These coats also render the surface more waterproof and wear resistant. Surfaces so applied have been put to several severe tests, such as immersion in water for 24 hours, exposure to sunlight, wind and rubbing.

The lacquer can be used effectively for gluing the map to the galvanized iron base of a fire locater. Apply a thin coat to the back of the map and place it on the fire locater immediately; the lacquer dries very quickly. Brushes used in this lacquer must be cleaned at once after using.

The material is highly inflammable and caution must be used to keep it away from fire or heat. It is difficult to remove from any part of the body and care should be used not to come in contact with it.—*Clay V. Castleman, Project Superintendent, Gardner National Forest.*

PROGRESS MAPPING OF FIRES

B. H. PAUL

Department of Forestry, County of Los Angeles, California

Following the big fires of October, 1935, at a fire review in which all phases of the action were discussed and studied, there was one significant fact outstanding: In the heat of battle fire fighters lost track of time and place especially in regard to the location of the line at particular times.

Conflicting opinions from reliable and experienced Wardens indicated that memory alone could not be relied upon. Periodic runs, flash-overs, patterns, spreads and "tie-ins" of converging lines were hopelessly lost in the variance of eye witness testimony.

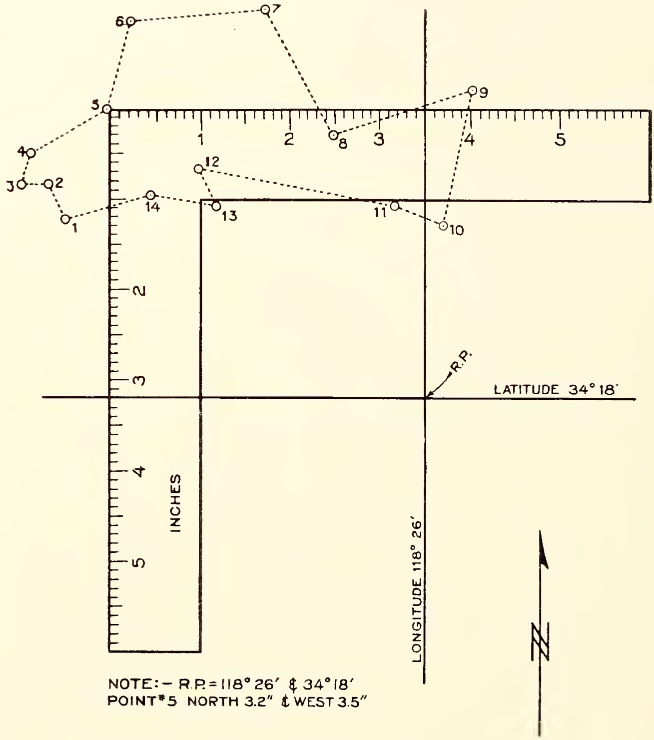
Clearly it was evident that some means had to be taken to overcome this particular problem and prevent its recurrence. In the accomplishment of this, there has been developed a new fire line unit. Two men of the Department's Intelligence Division, both experienced topographers and map men, now are assigned special duty as fire line mappers. It is their job to proceed at once to the scene of a major fire and begin charting the perimeter by time intervals. The object is to obtain data on rate of spread and pattern design, and to delineate a permanent chronological record of the behavior of the fire. If the burned area becomes too great for two men to adequately cover, additional mappers are assigned.

One of the objectives is to determine the position of the fire line at the end of the first hour. Another traverse is completed at the end of three hours, and thereafter the line is recorded by six-hour periods.

Intimate knowledge and familiarity with the terrain and road system by mappers is mandatory in order that travel time and distance may be reduced to an absolute minimum in reaching different sectors and observation points. Actual observance of the line is required, for even reasonable guesswork is discounted. The Pauline altimeter is used to facilitate this work. This instrument, reading to the nearest five feet of elevation, is adjusted and set at the closest U. S. G. S. bench mark to the scene of survey. It is possible by using the altimeter in conjunction with a reliable topographic map to follow accurately or spot the fire line in all its meanderings and deviations. The advantage of this method over that of transit and stadia is obvious.

The line is charted as fast as the observer can travel over the ground. At regular intervals the position of the line is in turn plotted and recorded at headquarters and in the fire camp through telephone communication.

This is accomplished by the simple method of describing a chain of traverse points whose location is designated by coordinates. A reference point is first given, being the nearest intersection of meridians of latitude and longitude. Measured either left or right and up or down, or east and west and north and south, from this point, prominent or control points along the line are spotted and, by connecting these points, the line is defined. A celluloid coordinate scale is employed to facilitate this operation. This scale measures both coordinates at the same time. The outer edge of this "L" shaped scale is graduated in inches and tenths of an inch. The designated point on line is located by sliding the scale along both meridians in radial direction from their intersection or reference point.



Coordinated Square Scale Used in Fire Line Platting.

The phoned message from the mapper to the dispatcher is carefully logged, repeated and verified. A typical example of this is:

6 m Partial fire line report from E. N. October 19. Call from phone-box 29. Base sheet Sylmar Quad. R. P. 118° 28′ and 34° 18′.

1.	North 2.0	West 4.0	
			Cold trailed Fire burning northerly
2	North 2.4	West 4.2	
			Hot line
3	North 2.4	West 4.5	
4	North 2.7	West 4.4	
5.	North 3.2	West 3.5	
			Cold line
6.	North 4.2	West 3.3	
			Hot line
7.	North 4.4	West 1.8	
8.	North 2.9	West 1.0	
			Burning slowly
9.	North 3.4	East 0.5	
10	North 1.9	East 0.2	
11	North 2.1	West 0.3	
			One lick line, few hot spots
12	North 2.5	West 2.5	
13.	North 2.1	West 2.3	
			Cold Trailed
14.	North 2.2	West 3.0	
	Closure to Point 1		

Repeated by Roth, checked back E. N.

The first actual application of this method of chronological fire line recording was on the Cold Creek fire of September 7, 1936. This fire spread for approximately three days before being brought under control. At regular intervals the position of the line was plotted as described, and concurrent with this plotting, the fire line map at the fire camp and at headquarters was charted. The latter was important in that accurate and definite description could be supplied at any time for press notices, dissemination of information to individual property owners whose interests were concerned, and for technical purposes.

When the fire was over and the final lines checked, this method had provided a permanent record covering the course, rate of spread, and typical patterns of the burn in all its stages. The original field map is subsequently reduced or enlarged in scale to a size which conforms to standard sheet in the Fire Burn Map Book.

BACKFIRING EQUIPMENT

Fred W. Funke

Fire Equipment Specialist, Region 5

Clean burning of lines is sometimes risky. When this is true it is often still more risky not to clean burn. Many fires have been lost because men chose, in effect, to run the greater risk of not burning out the lines. In many other cases fires are lost because the burning out of lines is neglected even though burning would have been safe and simple if done promptly. Part of the remedy lies in providing better backfiring equipment. Most men who see Mr. Funke's flame thrower work in competition with other backfiring equipment believe that the flame thrower has rendered other torches obsolete.

One of the favorite methods of controlling large fires in the early days of organized fire suppression was to withdraw to a convenient road or other barrier and ignite the fuel on the ground. The backfire thus created soon spread, leaving in its wake an increasing width of burned area which isolated the main fire from the barrier. "Acres Burned" did not receive as much consideration as "Cost Per Acre."

Matches, cedar bark and other local fuel torches usually provided a ready means of carrying the backfire along the line selected. Even today, such devices are a valuable supplement to regular mechanical equipment.

Improvement in fire control technique indicated the need for equipment which would speed up the firing of control lines so that such lines might be placed close to the main fire. The goal: a material reduction in the acreage burned on the average fire. The record is not quite clear but it is probable that some rancher in Southern California introduced the orchard heater (smudge pot) lighter to the field of fire suppression by starting a good backfire to protect his property.

Since the advent of the smudge pot lighter various mechanical designs have appeared. Each has contributed a share in the development of method for greater speed in the control of forest fire.

Mechanical backfire equipment may be loosely grouped in three classes:

1. Gravity Feed.
2. Blast type pressure torches.
3. Flame Thrower.

1. There are several designs of the gravity feed type. The smudge pot lighter is probably the most popular due to low cost. The great number of models available in this type are essentially the same, having a container in which the kerosene fuel is carried and a long spout through which the fuel is fed by gravity to the object at which it is directed. Attached to the spout is a tube which holds a cotton wick or taper. This is saturated with fuel.

ignited and thereafter receives a few drops of fuel each time the lighter is tipped to flow the fuel on some object.

Low temperatures caused difficulty in the ignition of kerosene and eventually an ingenious, but unthinking person added gasoline to the kerosene to make it burn more rapidly. The result was disastrous in a number of cases and this type of device is not now in general use for backfire work.

There are many types of gas pipe wick torches which have trailing wicks. The hot wick warms the kerosene as it flows to the ground and ignites the material covered by the oil.

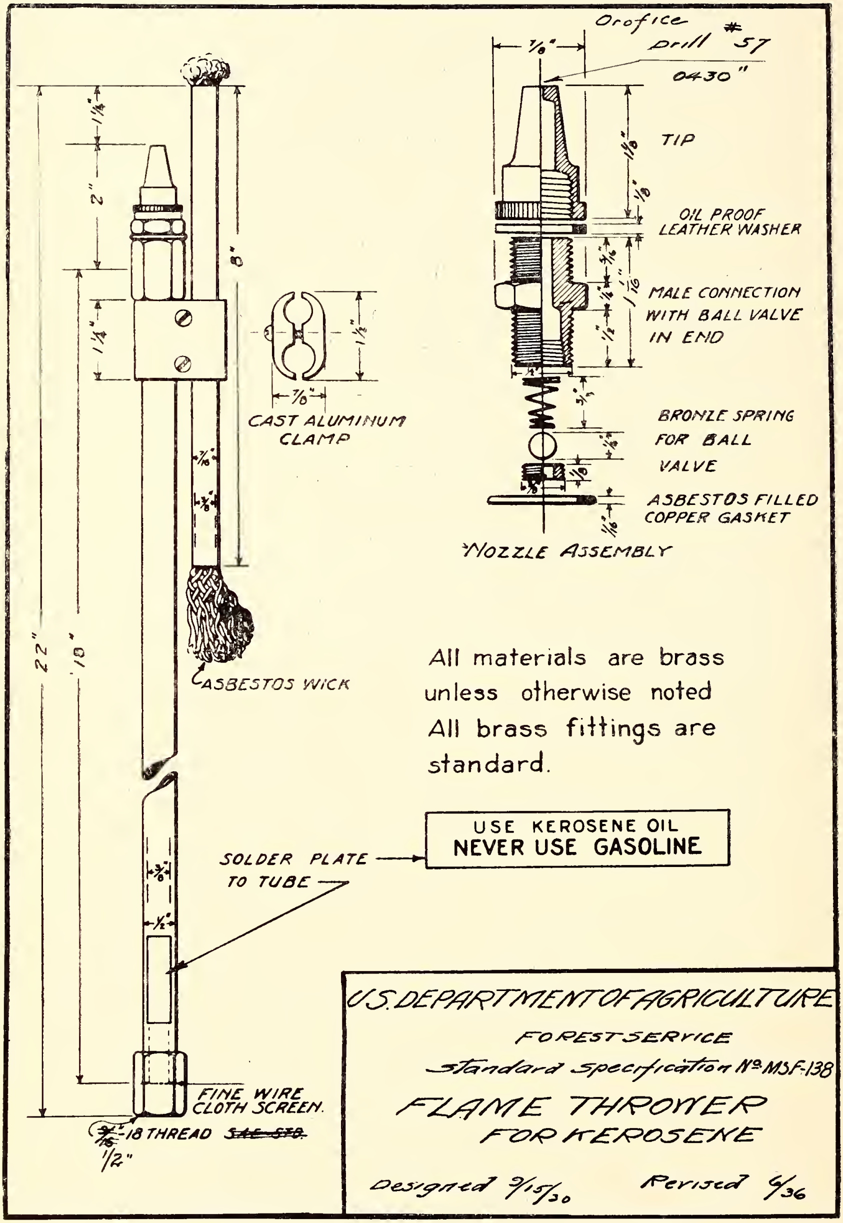
2. In the blast type group are the familiar kerosene torches which are enlarged models of the plumber's blowtorch. The early types used kerosene fuel. Gasoline also could be used in such torches and it is probable that in most cases a mixture of the two fuels was found to be most satisfactory. The troublesome preheating required in torches of this type along with carbonizing and clogging of the orifices in the burner soon caused the kerosene torch to fall into disfavor.

A number of agencies became interested in 1929 in the development of a burner which would handle a liquid gas fuel which, up to that time, was largely waste product in the separation of gasoline from crude oil and wet gas drawn from oil wells. The application of this type burner to backfire operations was sponsored by Region 1 of the Forest Service in 1931 and many outfits of this type are now in use. As compared to the kerosene torch, the preheating troubles are eliminated; one container of fuel will outlast many times its volume in kerosene and deliver approximately twice the amount of heat. The fuel is cheap. Performance of the burner is reliable and it is not affected by low temperatures.

3. The Flame Thrower is a device developed in the California Region by the Forest Service. It has been patented by the Forest Service and is dedicated to the Public.

The Flame Thrower attachment consists of a tube having a ¼-inch iron pipe thread on one end which will fit the Indian and Forester type pump furnished with standard back pack outfits. The fuel used is kerosene, saw oil. Diesel oil and fuels of similar grade. Gasoline should never be used with this device.

The fuel is passed through a check valve on the pressure stroke of the pump which causes a definite type of turbulence in the oil. This is collected in a specially designed chamber in the nozzle so that the fuel leaving the orifice consists of a solid stream surrounded by a fine wall of oil vapor.



Orofice Drill #57
.0430"
TIP
OIL PROOF LEATHER WASHER
MALE CONNECTION WITH BALL VALVE IN END
BRONZE SPRING FOR BALL VALVE
ASBESTOS FILLED COPPER GASKET
NOZZLE ASSEMBLY
CAST ALUMINUM CLAMP
ASBESTOS WICK
All materials are brass unless otherwise noted
All brass fittings are standard.
USE KEROSENE OIL
NEVER USE GASOLINE
SOLDER PLATE TO TUBE
FINE WIRE CLOTH SCREEN.
-18 THREAD ~~SAE STD.~~
1/2"
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Standard Specification No. MSF-138
FLAME THROWER FOR KEROSENE
Designed 7/15/30
Revised 6/36

Attached to the upper end of the flame thrower is a bracket which holds a taper or wick tube in place. The end of the tube should be approximately $1\frac{1}{2}$ inches beyond the nozzle tip and the wick should overhang the tube the same length.

The back pack outfit is prepared for use by filling it with fuel and pumping through sufficient oil to saturate the wick. The wick is ignited and the pump is operated in the usual manner. On the pressure stroke of the pump the oil vapor surrounding the oil stream is ignited and carries fire with the projected oil to a distance of approximately twelve feet with considerable unburned oil reaching the objective. The wick should be held below the nozzle so that the last few drops passing through the nozzle will keep the wick saturated. If there is a strong wind blowing it will be necessary to hold the wick against the wind so that the flame from the wick will cross over the projected oil stream.

The oil is used cold and there is never any heat present at the nozzle tip except that supplied by the wick. As a safety measure, the oil is cut off at a pressure of approximately five pounds and will not leave the nozzle until a greater pressure is supplied on the compression stroke of the pump. A strainer in the base of the tube removes foreign matter from the fuel. The purpose of the long tube is to place the nozzle a convenient distance away from the operator. While the flame created does not approach the nozzle closer than six inches, the radiated heat from the blast is intense and it is more practicable to keep the operator at a distance for comfort.

A Comparison

The Flame Thrower vs. The Blast Type Torch

The above view is a night photograph which illustrates the difference between a propane torch flame and the lighted wick of a flame thrower.

The propane torch will be readily recognized as the lower flame. Distance from camera—10 feet.

Flame produced by the flame thrower on the pressure stroke of the pump. Distance from camera—40 feet.

The above views show the dispersion of the flame when directed to ground. Distance from camera—35 feet.

Burning green cut slash on right-of-ways during wet weather is an important application in areas where the fire hazard is great. Many other uses have been found for the device, some of which are totally unrelated to fire protection work.

Flame Thrower Operation

The flame thrower is, in the hands of an experienced operator, a highly efficient tool and can be used with perfect safety. Like any other equipment in the hands of an inexperienced person, the flame thrower can be a lethal weapon. Men of mature judgment and experience only should be permitted to use the device. CCC enrollees should not be permitted to use flame throwers under any circumstances.

Care should be taken that fuel oil is not spilled on the clothing of the operator and that the outside of the container and straps are dry. The danger is not so much from the flame thrower itself as from passing too close to burning material.

Caps on the container should be tight.

Pump packing and hose connections should be tight. Every precaution should be taken to prevent leakage of the fuel oil.

It is hoped that forests which have not tried the flame thrower will attempt a few experiments with it in comparison with regular propane or other type blast torches. The device is inexpensive and can be obtained through requisition on Supply Depot, Oakland, Calif., or jobbers in San Francisco.

PRELIMINARY AIRPLANE DELIVERY EXPERIMENTS ON THE CORONADO

A. M. GARDNER

Senior Forest Clerk, Coronado National Forest

The Coronado National Forest made several experiments in dropping supplies and tools from airplanes in preparation for the possible use of airplane transportation of materials to isolated fire lines during the fire season of 1937.

Experiments were carried out with two planes which had been put under agreement for the season; one a Waco 4-place, cabin biplane and the other a Travelaire 4-place, cabin, high-wing monoplane. The experiments were conducted along lines of those described in the April 12 issue of FIRE CONTROL NOTES, retarders (parachutes) being used for all drops. A total of eleven drops were made, as shown on the following tabulation:

The first four drops were made from the Waco biplane. No difficulty was experienced in dropping the packages from the plane. The door opening directly over the lower wing was removed beforehand and seat cushions were removed from the rear seats. A large step plate is located on the wing at the door. As the plane approached the target, the package to be dropped was rested on the step plate just outside the door. When the target was reached, the package was shoved back off the wing.

The other seven drops were made from the Travelaire plane. The door had been removed from this plane and the packages were rested on the doorsill until the target was reached and then pushed out, there being no wing in the way.

The parachutes used were 7 x 7 feet and 9 x 9 feet, burlap or woolsack material with braided sashcord shrouds tied to each corner. These shrouds were about 18 feet long. Small blocks of wood were tied in the corners to prevent slipping of the shrouds.

The chutes were spread out, doubled once and then folded from the side by an accordion fold, the folds being about the width of the top of the package to be attached. This folded chute was then doubled down to the other dimensions of the top of the package by again using an accordion fold. The shrouds, which are attached to both package and chute, were straightened out and then, all four together, were knotted loosely in a chain stitch type of knot, beginning at the package end, taking up the full length of the shrouds. This "chain" must be loose enough to pull out without any

trouble. The shrouds and chute were then doubled up on the top of the package, chute on top, and light-weight cord was used to tie over the chute holding it to the package.

In the plane, a heavy sash cord about 12 feet long was fastened by one end securely to the plane (safety belt fastener in one instance and strut in the other). When ready to drop, the other end of this rope was tied to the light cord which holds the folded chute in place on the package. The package and chute drop together until they hit the end of the rope, where the rope breaks the light cord lashing the chute to the package, and releases the chute. The rope is pulled in and tied to the next package.

Two chute failures occurred. The first one, folded as described in the April 12 article, failed to open completely and the package was damaged. The second failure, drop No. 8, was due to the cord lashing the chute to the package being too strong. The rope fastened to the plane broke instead. This method of discharging the packages greatly simplifies the job of the dropper. There is little danger of the chutes becoming entangled with the control surfaces of the plane as the chute is released full length of the rope away from the plane and directly beneath it.

With the exception of the first two packages, which landed from 100 to 150 yards from the target, all the drops landed within about 50 yards of the target. The following is a tabulation of the packages and the results of the drops on April 29 and May 1, 1937:

Drop No.	Ht. Ft.	Appr. Wt.	Chute Size	Package	Results
1	650	30 lbs.	9′ x 9′	Small box packed inside powder box, to approximate fragility of type "S" radiophone (eggs, etc.).	Chute failed to open completely, eggs and light bulbs broken. Ink bottle and box OK.
2	650	54 lbs.	7′ x 7′	Four 1-gallon canteens packed in horseshoe keg, stacked on sides, excelsior in bottom of keg.	Chute opened OK but impact of landing forced caps off two canteens, losing contents.
3	800	30 lbs.	7′ x 7′	Same package as No. 1 except eggs and bulbs were not replaced.	Chute opened OK and package landed without damage.
4	800	45 lbs.	7′ x 7′	Same package as No. 2 except canteens were packed upright.	Chute opened OK and package landed without damage.
5	200	30 lbs.	9′ x 9′	Same package as No. 1 with two radio tubes in package.	Chute opened OK and package landed without damage.
6	200	40 lbs.	7′ x 7′	Five-gallon canvas water bag filled with water, inside burlap sack.	Chute opened OK and package landed without damage.

7	200	50 lbs.	7′ x 7′	Six l. h. r. p. shovels wrapped in canvas.	Chute opened OK and package landed without damage.
8	150	60 lbs.	7′ x 7′	20 cans vegetables in wooden box.	Chute failed to open. Contents demolished except four cans dented but retaining food.
9	150	40 lbs.	7′ x 7′	Same package as No. 6 with same water.	Package landed without damage.
10	150	50 lbs.	7′ x 7′	Same package as No. 7.	Package landed without damage.
11	150	30 lbs.	9′ x 9′	Same package as No. 5.	Package landed without damage.

Communication between plane and ground was maintained by means of two Type "S" UHF Transceivers. Considerable difficulty was encountered in receiving in the plane due to the open door and the roar of the motor and it was necessary to cut the motor to idling speed in order to understand the transmissions of the ground set. The transmissions from plane to ground, however, were all received in fine shape.

It is believed that with the experience gained from these tests the Coronado should be able to make dependable emergency delivery of supplies to inaccessible fire lines within an hour or two, which would otherwise require a very much longer time.

THE LOOSE AXE-HANDLE BOGEY

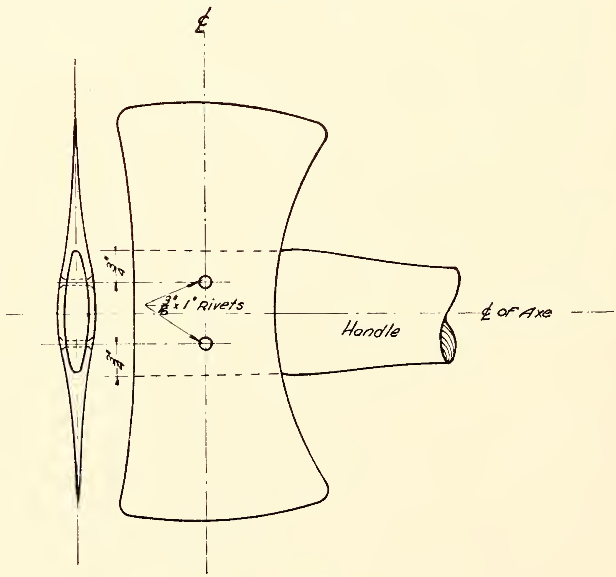
FRED W. FUNKE

Fire Equipment Specialist, Region 5

Much has been written on the subject of tightening loose handles in axes. Various methods by which handles can be made permanently tight have been suggested. Treatments recommended usually require immersion of the axe and handle in special compounds, boiling in linseed oil or other solutions. After all the years, however, loose handles are still a problem.

An analysis of the problem indicates that most of our thinking has been concentrated on a remedy for a condition, rather than an investigation of the cause. Knowing the cause, it should be possible to devise a control which, while not complete, would be effective in a practical sense.

Why not dig into the problem a little more deeply? An axe handle as received from the manufacturer contains a variable degree of moisture. One shipment might contain a high percentage of moisture; the next a lower amount. In short, there is little uniformity, and while it is true that handles of a given grade and quality are supposed to have a stated maximum moisture content, it is safe to assume that in handles supplied to the trade this will vary over a rather wide range. Even if the handles furnished were reduced to the maximum moisture content acceptable to a particular buyer, subsequent storage in a moderately damp location would cause the handle to absorb moisture above the percentage which the handle contained when received.



Wood is hygroscopic; that is, it will absorb moisture from the atmosphere when its moisture content is less than that of the surrounding air. It will return moisture to the atmosphere when the air is less moist than the wood. In absorbing moisture the wood cells expand; and alternately, drying causes shrinkage. The alternate expansion of the wood structure as it absorbs moisture and shrinking as it dries out cause no particularly harmful effect unless the wood is confined under pressure as is the case in the eye sheath of an axe. Under such conditions there is a partial crushing of the cell structure with each cycle of expansion and contraction, until a partial permanent set takes place in the wood. A loose handle in the axe is the result. Rewedging of the handle is a temporary remedy only since the process continues and eventually the axe handle again becomes loose.

The normal method of tightening an axe handle is to insert a soft wooden wedge. This action produces a springing effect in the head and sets up a heavy pressure between the inside face of the axe eye and the wood of the handle. Properly hung and wedged, handles should remain tight and would do so but for the hygroscopic quality of the wood.

Now; if, instead of producing an expansion effect in the wood of the handle by wedging, a compression effect is introduced from the outside of the axe eye, the same result will be attained and also a method of tightening the axe is provided which is much more practicable than rewedging.

The method consists of drilling $\frac{3}{16}$-inch holes through the axe at two points approximately ¾ inch in from the edge of the eye along the center line of the axe, countersinking each face and inserting $\frac{3}{16}$ x 1-inch, countersunk-head, steel rivets. In setting these rivets in place a normal sidewall pressure is exerted on the axe eye which will lock the handle in place. Wedging the handle is not necessary. Should the handle become loose in service it is necessary only to hammer down the rivets a little more closely to restore the sidewall pressure on the eye and tighten the handle. Riveted axes will never rock on the handle and will not fly off. On the forests which have tried the method, no difficulty has been experienced in removing the rivets for rehandling.

This particular idea has been tried with considerable success on the standard Forest Service brush hook, and thus far there is no record of loose handles in such tools. It is hoped that the field will find the idea of sufficient interest to try it out during the coming season and, if found to be of value, to so report through regular channels with a recommendation for adoption of such a requirement in axe purchase specifications.

DEVELOPMENT OF THE BOSWORTH TRENCHER

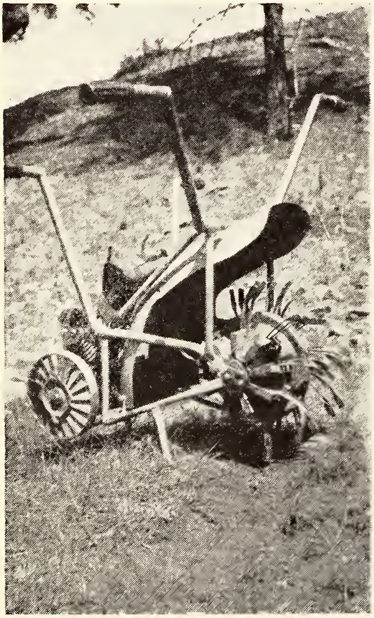
C. S. Crocker

Fire Inspector, Region 1

The attempt to develop a machine which would build trench through the action of a rotary brush has received previous brief mention in Fire Control Notes. This is the first progress report on the project.

The idea for a trench-building power-driven brush came from J. H. Bosworth, Assistant Supervisor on the Kaniksu Forest. Construction and experimental tests are handled by the Regional Equipment Committee.

One machine has been assembled, largely from material salvaged from junk piles and nondescript gadgets picked up at random. Bicycle frame tubing built the chassis. An air-cooled outboard motor provides the power; an automobile fan belt transmits the power to the brush. The working model, completely equipped and fueled, weighs 60 pounds. When the handles and fuel are removed, the weight is roughly 50 pounds. It is designed for back pack transportation.



Two views of the power-driven rotary brush.

Recent tests indicate that the principle of brushing out a trench is practical. It eliminates excess depth and extra width usually found on hand-

made trenches. It eliminates the pile-up of debris immediately inside the trench. The brush scatters light fuels over a distance of 4 to 12 feet inside. If desired, by deeper trenching a layer of dirt can be evenly distributed or concentrated on spots within this distance.

The present model lacks the power necessary for fast construction in heavy sodded or matted duff. New machines will be powered with larger motors if it is possible to purchase or build air-cooled engines of the required power within weight limitations.

In yellow pine, lodgepole, and grass type fuels the present model builds a trench 8 to 12 inches wide at the rate of 2,000 feet per hour, requiring the use of two men. This is at a rate of 15 chains per man-hour. It is expected that the proposed power increase will raise this production 50 per cent.

Difficulty to be overcome, other than power set-up, is largely confined to obtaining a brush which will withstand the severe use. Spring steel, cushioned in crepe rubber, is used at present. The field is being canvassed for other types. Another alteration will change the handles so that one man will not need to travel backward.

A brush trencher of wheelbarrow type, to be a one-man machine, is being designed and will be reported on later.

Two more units similar to the one illustrated are being built to be put in the field for testing on actual fires this summer, and a report of these experiments will be made through the NOTES at the close of the season.

Aerial Control in Russia—Planes are also utilized for extinguishing steppe fires, which are a serious menace to pasture land. An illustration of this danger is the fire which occurred two years ago at the Nishan Persian Lamb State Farm in Uzbekistan during which 58,000 acres of the best sheep runs were destroyed. Ordinary methods of fighting the steppe fire are not very effective, while scattering caustic soda from a plane has proved very successful. A ton of caustic soda is enough to form a protective belt stretching for five kilometers.—*Quoted from* MOSCOW NEWS, *Moscow, Russia.*

WATER TRANSPORTATION BY TRUCK

Arthur M. Emmerling

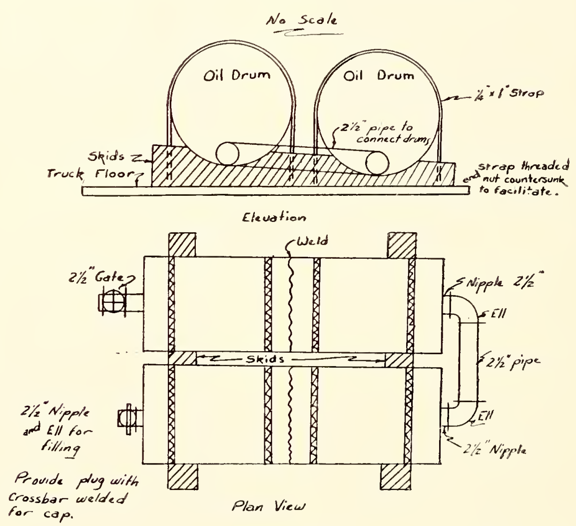
Project Superintendent, Manistee National Forest

A satisfactory truck tank can be made from four oil drums and if properly arranged will prove acceptable in replacing some of the present water containers.

The attached sketch illustrates a tank constructed from four 55-gallon oil drums (not Sinclair) welded together in a double hook-up, giving a capacity of 220 gallons. It has a single inlet and outlet. Back-pack pumps and pails are easily filled and a hose may be attached.

The tank is stationary, but it is not difficult to transfer to another truck when empty. Seats may be built over the top or a platform constructed so as to haul additional fire equipment. Undoubtedly the life of this tank will be considerably longer than any of the present water containers used on the forest.

SKETCH OF OIL DRUM WATER TANK



Capacity 220 gals.

QUESTIONS AND ANSWERS

Suggestions have been made that a Question and Answer column might become an enlivening and perhaps provocative feature. We are inclined to give it a try and here are four leading questions sent in from the field. More are invited. They can be signed or unsigned. Unlike most such columns the Editors will not answer the questions. That is a function it is hoped the subscribers will perform. Answers which throw light on these questions will be welcomed and published. Please keep them short.

1. How do lookouts discover fires? Is it by casually looking over a familiar scene with a subconscious thought of noting any unfamiliar object? Or, is it by carefully searching out every nook and cranny of the surrounding terrain with both mind and eye constantly on the alert for smoke of unconsciously preconceived dimensions, color and shape?

2. What is the annual cost to the Forest Service, not only in dollars, but also is loss of time and performance efficiency due to the use of ostensibly inadequate specifications, and to the lack of standardization of specifications for equipment items of inter-regional use?

3. Is it possible to develop super-intelligent fire dispatchers, who, through exceptionally intensive training plus the necessary background of diversified fire control experience, can perform adequate fire dispatching at all times and under all conditions, without the aid of fire weather, fire behavior, fuel type, manpower, transportation guide charts, tables and other dispatching devices, many of which at present lack considerably in satisfactory precision and accuracy? If so, is it practical and how may it be done?

4. Assuming that fire control must carry on with the average dispatcher and that basic information readily available and in usable form is necessary to insure adequate performance, pertinent to what basic factors must reliable information be provided? How can it be obtained? How should it be prepared in order to be in readily usable form?

CALIFORNIA SUPPRESSION TRUCKS

MERRITT B. PRATT

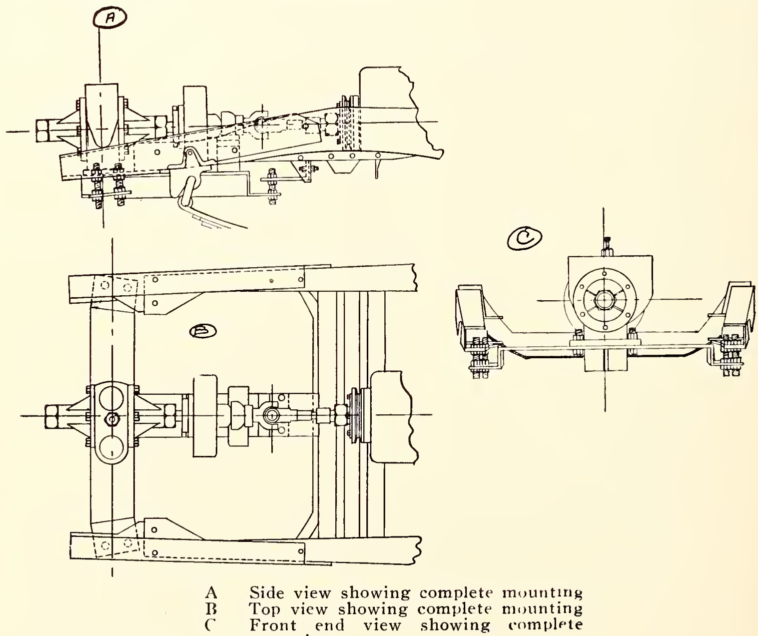
State Forester, California

Tank trucks are always a live equipment subject, and improvements are constantly being made both by the Federal and the State forestry agencies. In California particularly, there is much such activity and the State Forester here describes what appears to be a very nice job.

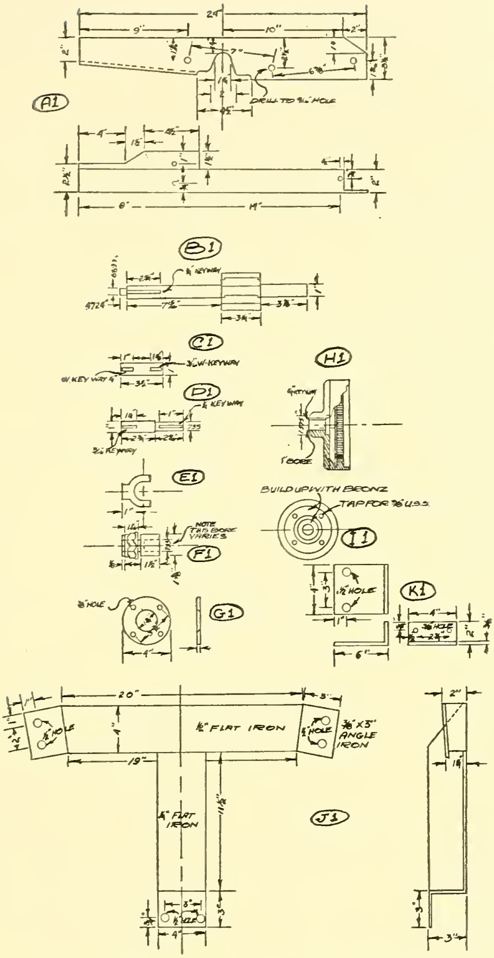
The tank truck that is finding most favor with the men in the field is a unit designated as a "suppression truck" built for combined use as tanker and as a transportation unit to carry suppression crews not exceeding ten men.

The latest trucks have been equipped with the Hercules Roller Type Pump, Model 6-A, mounted on the front end of standard makes of 1½-ton trucks, 131 inches wheel base, low gear ratio differentials and oversize radiators, with a steel express body. The pump is driven by fastening a flanged, hydraulic-type universal joint to the fan pulley, extending a short shaft under the radiator and connecting to another universal, both joints

HERCULES TYPE "6A" WATER PUMP FRONT END MOUNTING FOR 1935 AND 1936 CHEVROLET 1½-TON TRUCK



A Side view showing complete mounting
B Top view showing complete mounting
C Front end view showing complete mounting



A1 Frame extension showing holes and cut-aways
B1 Rotary and shaft showing key-ways and pilot bearing end
C1 Pillow block shaft showing key-ways
D1 Universal Joint shaft showing key-ways
E1 Face one end of universal joint; use No. 6857-7-SE spicer joint
F1 Garwood joint 15/16" bore face of female end and weld to plate G1
H1 Use No. 3A Diamond "D" Friction clutch
I1 Build up crank shaft pulley with bronze and face
J1 Pump frame; weld angle iron to flat iron
K1 Cross-member plate

being held in line with the crank shaft by a pillow block bearing placed between the front joint and the clutch. A Model 1 A Diamond D cut-off clutch is used with the control lever entering the cab between the left door and the steering column.

The mounting used to carry the pump, clutch and pillow block bearing is constructed of two 3/8 x 2 x 3½-inch angle irons that are bolted to the front end of the frame from a point back of the radiator to the tip end, from where they extend ahead six inches beyond the frame, the bumper being fastened to the end of this mounting. The part extending beyond the frame has a piece of iron 3/8 x 3 inches welded to the angle making a channel. A cross piece ½ x 4 inches is fastened to each side by means of two ½-inch studs with nuts on each side of the channel and the cross piece to allow adjustment up or down. Another piece of iron is welded to the back edge of the cross piece and extends back to the front cross member where it is fastened to a bracket in the same manner as the cross piece, to allow for an additional adjustment to give the pump perfect alignment with the crankshaft.

There is a suction and discharge connection on each side of the pump with the necessary piping running back to the rear of the cab, where additional suction and discharge connections are placed on each side of the truck, the suction side extending under the tank where a valve, controlled from the left side of the truck, may be closed to allow for drafting from outside sources. The discharge side enters the tank at the top through a 1½-inch valve for filling with a 1-inch lateral going to a 300-foot-capacity live reel mounted on top of the water tank and parallel with the bed of the truck.

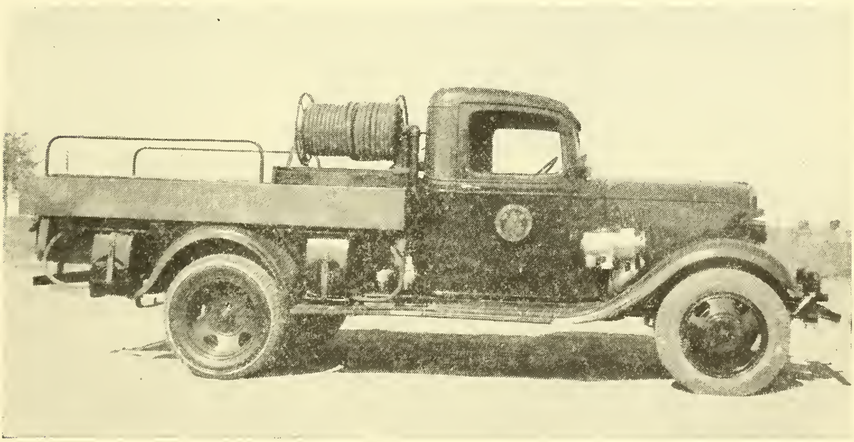
The tank is approximately 45 x 39 x 24 inches high with a capacity of about 190 gallons. The last tanks built were of 14-gauge, black iron, welded with baffles running both ways. After welding the tank is treated with a rust-proof compound.

Back of the tank, on each side, is placed a combination tool box and seat, 66 inches long, 18 inches wide, and 20 inches high, the cover being upholstered. A pipe railing is placed back of each box as a back rest. Two additional boxes are built to fit the outside of the body, full length, 10 inches high and 10 inches deep. On one side three lengths of 2-inch suction hose and necessary adapters, spanners, etc., are carried, and on the other side 500 feet of 1-inch cotton hose. Four back pack pumps are carried, two on each side.

The pressure gauge is mounted on the dash, and a lead taken off through a valve to the cooling system of the engine. An extra overflow pipe is installed to prevent any chance of rupturing the radiator.

Our patrol cars (pick-ups) are equipped with the same size pumps, and piped the same as the suppression trucks but using a 50-gallon tank with the reel mounted on top and a smaller number of hand tools. All pumps used on the patrol cars to date have been the number two Viking driven from the transmission, but in the future it is expected the front end mounting which gives a constant pressure that is lost on the transmission hookup whenever it is necessary to stop or shift gears will be used.

Our straight tank trucks have all been of a capacity of from 235 to 275 gallons, the tank setting close to the frame, and of a dimension the same width and length of the frame back of the cab. Tool boxes are mounted the full length of the tank and are 12¾ inches high by 13 inches wide, and are mounted so the bottom of the box is even with the top of the tank, thus forming a hose rack on top of the tank that will carry 500 feet each of 1-inch and 1½-inch cotton hose.



Right side view of 1936 Suppression truck built by California Division of Forestry.

The reel is mounted at the front and above the tool boxes. The suction hose is carried over the fender. A full width rear step is provided and allows for the mounting of two pack pumps and one back fire torch, two additional pumps being carried on the running boards.

The piping arrangement is the same as on the suppression truck, with the exception that there is a suction outlet at both the front and back of

the tank with a three-way valve to allow closing either or both of the outlets. A float valve is being developed to be used on the inside of the tank which will close either opening when the water is too low on that end of the tank when on an incline. One gate valve will be placed in the line to shut off the supply from the tank when drafting. This it is hoped will eliminate some trouble experienced with the three-way valve.

Another feature that is being embodied in the tank trucks is a foot-valve on the end of the overflow that opens to full capacity when the valve is opened for filling the tank from the pump. This eliminates the possibility of rupturing the tank from pressure. The tension is so slight that the valve will automatically open if there is a vacuum, which prevents collapsing the tank, and while on the road prevents any loss of water from the tank. Some trouble has been experienced from skidding on turns when the overflow was open at the front end due to the surge and the water being deposited ahead of the rear wheels.

THE "ONE LICK" METHOD ON THE CHIPPEWA

Chippewa National Forest

The principle of the One Lick Method is receiving more and more application and shows signs of turning up something revolutionary in fire line construction practice. This record of comparative results comes from a Ranger District on the Chippewa and is a spur to more rapid development of a most promising technique.

The method used is that described in the article on page 23 of Fire Control Notes of December, 1936, with some modifications. The system was discussed somewhat on this Ranger District in 1936, but since we were fortunate in not having fires of any size, the system was not tried out until this spring.

The factors which influence the line organization are as follows:

1—The number of men available.

2—The type of cover.

3—The ground condition. (Rocks, peat, heavy roots, etc.)

4—Intensity of the fire.

In aspen-brush type with sandy soil, our organization has been about as follows:

Men	*Tools*
1 "trail blazer"	cruiser axe or machette
2 men	one cross-cut saw
5 men	brush hooks, preferably the finn type
10 men	long handle round point shovels
1 man	mattock
1 man	back fire torch
2 men	back pack pumps
2 foremen	no tools

This size crew was timed during the spring fire training. The crew at that time made 18 chains of line through medium heavy aspen-brush type in 20 minutes. The control line was cut and cleared 8 feet wide, and the trench was dug half a shovel deep and two shovels wide. The length was measured with tape—not pacing. On inspection, the line was found to be quite uniform except a few places where a finishing touch was necessary. The two foremen were used to coordinate the work and see that the men moved on at a uniform pace. They had to move on a "trot" in order to be useful. On a well-trained crew, one foreman behind the line might be sufficient.

We have not done any special timing on our fires, but we have used this

same organization with some variations. When we review the accomplishments with those of last year there is a distinct difference: The number of man hours spent in constructing a safe line around the fires after corralling has been cut in half.

On the Amen Lake fire of this year not over 35 man hours were used to build a safe line around a 4-acre fire—25 chains. On the North Boundary fire of 1936, we used at least 90 man hours to construct a safe line around a 2.8-acre fire—43 chains. The ratio is almost two to one in favor of this year's accomplishment.

On the Big Fork fire of this year we used 54 man hours to construct a safe fire line of 50 chains. On the South Suomi fire of 1936 we used at least 120 man hours to construct a safe line of 67 chains. The ratio here is also 2 to 1 in favor of this year.

The results on these fires may not be exactly comparable, but every effort was made to pick comparable conditions.

The one lick method is difficult to use without prior training and it takes much energy out of the men. During the spring training, all the overhead on the district took their turn at the work in the line. It was agreed that four would be the maximum number of hours one man could work continuously at such pace.

The system does not increase the need for overhead as had been expected. There is no need for pushing the line. The problem is to keep the men from getting too close to one another and to keep the right proportion between the different tools. It is necessary to trade tools at times or have an extra man carrying surplus equipment.

RECORD OF PREVENTION PROGRESS

REGION 8, FOREST SERVICE

The occurrence of man-caused fires this season on two of the new Forests of Region 8, when compared with last year's record, indicates that prevention efforts are beginning to take effect. This article and tabulation are quoted from the publication of the Texas National Forests and the statistics of the Mississippi National Forests.

What, if any, has been the change in attitude of residents of East Texas regarding burning the woods since the coming of the U. S. Forest Service to that section?

The following is an attempt to present a statistical answer with a minimum of editorial comment. It is well, however, to suggest that the following tables be studied with care, inasmuch as weather conditions and location have decided effect upon acreage, whereas the number of fires offers a surer reflection of the public attitude. Furthermore, more fires are classed as reportable this year than in 1936.

COMPARATIVE RECORD FOR THE FIRST FOUR MONTHS

TEXAS NATIONAL FORESTS

	1936			1937		
Cause	No. of Fires	Private Acreage	Govt. Acreage	No. of Fires	Private Acreage	Govt. Acreage
(Sabine)						
Smokers	7	39.0	55.83	15	25.7	90.67
Campers	6	9.0	18.85	4	35.6	71.8
Debris	2	1.5	89.0	3	5.6	128.5
Incendiary	102	....	2696.36	23	813.2	349.15
Miscel.	2	2121.0	8.0	....	....	....
	119	2170.5	2868.04	45	880.1	640.12
(Davy Crockett)						
Smokers	16	15.16	136.5	13	28.75	18.0
Campers	5	10.0	43.5	......	....	....
Debris	4	44.0	5.0	10	589.0	666.0
Incendiary	9	16.0	220.25	10	22.5	280.25
	34	85.16	405.25	33	840.25	964.25
(Angelina)						
Smokers	63	....	....	12	......	......
Campers	4	....	....	4	......	......
Debris	15	....	....	10	......	......
Incendiary	156	....	....	19	......	......
	238	2932	6686	45	298	228
(Sam Houston)						
Smokers	13	2.0	124.0	8	......	55½
Campers	....	......	....	2	7.0	1
Debris	5	6.0	8.0	1	......	3
Incendiary	7	13.0	139.0	..	......	..
Lumbering	4	0.3/10	....	1	14.0	..
	29	21.3/10	271.0	12	21.0	59.5″
(Total Texas Forests)						
Man Caused	420	5208.96	10,230.29	135	2039.35	1891.87

Comparative Record for First Six Months

MISSISSIPPI NATIONAL FORESTS

Cause	1936 No. Fires	N.F. Acres Burned	1937 No. Fires	N.F. Acres Burned
Railroads	15	....	1	3
Smokers	26	....	38	277
Campers	34	....	6	37
Debris Burners	156	....	31	1613
Incendiary	149	....	92	3102
Lumbering	315	....	20	1150
Miscellaneous	8	....	6	179
	703	17,048	194	6361

(OAKLAND-8-9-37-6,000)

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and that no paragraphs be broken over to the next page.

The title of the article should be typed in capitals at top of first page, and immediately underneath it should appear the author's name, position and unit.

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually directly following the first reference to the illustration.

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SEPTEMBER 20, 1937

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

WHAT FUTURE HAS FIRE CONTROL NOTES?

Amazing results may be produced by cooperation. Accomplishments by the AAA and labor and business groups are determined primarily by the degree to which the principle of cooperation is applied. The world of science would be relatively barren without the highly developed cooperation which has grown up among scientists. Where the spirit of cooperation has been well developed, fire control has an effectiveness which does not otherwise exist. Cooperation or the lack of it will make or break FIRE CONTROL NOTES.

If workers in fire control take a pride in this publication as the organ of their occupational group, they will be critical of published articles having only a mediocre quality; if they feel an individual share in the collective responsibility for the character and quality of FIRE CONTROL NOTES they will be on the alert for chances to make, or get others to make, contributions which will be appreciated by readers concerned with the new science and art of fire control. When they find published articles of value to them individually, they will be impelled to respond by distilling from their own work the things which, if written up, would be of value to others.

The time has come when the publication will inevitably have tough going. The men most willing to contribute have done their share. The material most easily put in shape for publication has been printed. FIRE CONTROL NOTES will naturally feel the tendency to peter out. But it will take the upgrade promptly if workers in fire control really desire a publication devoted to that subject and cooperate to make it worthwhile. Will you individually do your share?

Address DIVISION OF FIRE CONTROL
FOREST SERVICE, WASHINGTON, D. C.

Published by

THE FOREST SERVICE — U. S. DEPARTMENT OF AGRICULTURE

September 20, 1937

CONTENTS

FIRE CONTROL NOTES

SEPTEMBER 20, 1937

Forestry cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and technology may flow to and from every worker in the field of forest fire control.

BLACKWATER FIRE ON THE SHOSHONE

Division of Fire Control

Washington, D. C.

Preliminary reports in hand as this issue goes to press show that initial action on this lightning fire was alert, prompt and vigorous—quite remarkably so, considering that the Shoshone is rated as a low-danger forest, and doesn't even have lookout stations. The country was high and steep—just below timber line. In spots the lodgepole and fir were dense and limby—the familiar patches of rather scrubby jungle found on the better sites at high elevations. There were steep slopes covered with dense but not jungly stands—just the setting for wind-driven crown fires of intense heat. Pictures of the area show bare ridge tops and open places here and there. Fuel on the ground seems to have been quite light—as would be normal under such conditions. One would guess that the fuel experts would rate the area at "Low rate of spread" and "Low resistance to control." But when the "heavy" wind started sweeping this way and that on Saturday, August 21, fifteen men lost their lives. Six of these died from their burns after the blow-up.

The danger from such accidents probably is statistically less than the danger from automobile accidents, which is so familiar we largely ignore it. But such fire accidents do happen and impress us all the more because of their infrequency. This is the largest loss of life from a single National Forest fire since 1910. It is the irony of fate that it had to occur on a National Forest which, so far as can be determined from the records here, has had only one other large fire during its whole history. The latest reports on size of this fire put it at 1,100 acres.

To the men who died in this disaster, all fire control men everywhere pay tribute. To the bereaved families they extend the deepest sympathy. To the survivors, and particularly the exceptionally large number of in-

jured men, is extended appreciation and cordial concern from all those engaged in the high adventure of protecting American forests from devastation by fire.

District Ranger Post's statement is published as an authentic case record of the processes of judgment in such situations where a man must think first and think clearly about the safety of the men in his crew. His words will recall to all experienced men many days of harassed effort to get the line ahead and the fire mopped up before something happened—but always with a running accompaniment of a plan (sometimes unconscious) for the best way to safety for the crew if something went wrong.

His statement is also a technical case history of the handling of men in such crises. His record could be followed better with the aid of a map, but even without it much can be gleaned from the story.

As a record of unassuming heroic conduct the statement needs no comment. It was dictated straightaway in the presence of D. P. Godwin, with no rehashing or editing except the correction of the spelling of one name and the insertion of the name of Bert Sullivan in one place. Post has some bad burns, and both hands and both sides of his face are heavily bandaged. He is out of danger, but will bear scars.

Junior Forester Tyrrell of Ranger Post's party died later from his burns. In speaking of him in his signed statement, Enrollee Alcario Serros says:

> "Then we saw that we didn't have no chance to go back, so Ranger Post told Mr. Tyrrell to take care of us, and he took us up to the rim rock. The fire started from the east, and then south, and then the west. It was the west fire that burned us. As the fire came closer to us we layed down on the rock ridge. Mr. Tyrrell layed on top of me. When the fire burned Mr. Tyrrell he ran and I ran, too, about 10 feet."

District Ranger Clayton, whose message Ranger Post received, died with six of his men. A seventh got out, but died from his burns.

When cut off from the safety sought to the east above timber line in the picture, Post and forty men who followed his instructions survived by taking what shelter they could, first on the left (north) side, then the right side of this bare spot in a ridge. Junior Forester Tyrrell died later from burns inflicted by the flames and heat which swept over them.

STATEMENT BY RANGER URBAN J. POST

I was in camp at the Road Maintenance Camp on Granite Creek, Shell District, Bighorn National Forest when I received a telephone message through a summer home permittee at 12:30 a.m. Saturday morning, August 21, to the effect that Mr. Conner had ordered me to report to the Supervisor on the Shoshone Forest for fire duty. I left camp in a pick-up with an outfit probably not later than 12:40 or 12:45 and arrived in Cody at the Supervisor's Office at 4:30 a.m. Mr. Anderson and Mr. Marion were in the office on fire duty and it was there I learned that I was to have charge of a group of men coming from the Bighorn.

We talked the situation over and decided that there was nothing to be gained by my going into the fire area ahead of this crew, so it was decided that I would take the necessary tools from the fire stock at the Cody Warehouse, drive on as far as trucks were permitted to go towards the fire and await the arrival of the men. This was done and I arrived at the end of the truck road on Blackwater Creek approximately 9 a.m.

There was some delay in the men getting there and I believe it was 11:20 or 11:25 a.m. when the crews from the Bighorn arrived at the end of the truck road on Blackwater Creek. During the interval between 9 a.m. and 11:30 a.m. all preparations were made to handle the crew after their arrival, tools were laid out where they were readily accessible, the Army was requested to prepare food so that the men could be fed before they started up the trail and our men from the Bighorn were fed as near as I remember at Noon, 12:00 a.m. As soon as any reasonable number of men had finished their meal, I left orders with the Foremen, Tyrrell and James Saban, accompanying the men as to the tools to be taken and other preparations to be made.

James Saban arrived with the last truck load and was instructed to bring up the rear of the party and see that all the stragglers arrived on the job. At approximately 12:20 the head of the party moved up Blackwater Creek from the end of the truck road toward the scene of the fire. We continued right on up past the Upper Camp. At approximately 1:30 the head of the column arrived at the burn of Friday the 20th on the main Blackwater Creek. There we met Supervisor Sieker who outlined the action of the day before as nearly as possible, the conditions existing on the fire at that time, the length of time and condition of men who were already on the fire line, and I was instructed to proceed to the east with my party. We followed the edge of the fire with instructions to pick up all Cody Camp men who were on patrol, turn them over to their Foreman and send them in for

rest. Likewise, I was to contact the Foreman of the Park Service men and instruct him to the patrol line already built. We were to go beyond the line constructed which included line constructed by the BPR Party, who were east of the Park Service crew and start construction beyond this point.

Mr. Sieker informed me that the Basin to the east was the only bad place left, that the other portions were fairly well caught up, that he was very tired from his work of the day and night before, and that he would turn over the job in the Basin to me and he felt that he would have no worry. He told me that there had not been much line constructed to his knowledge in the Basin and that after that part of the line was controlled, he was sure that the whole fire would be managed. In fact, our conversation led me to believe that there was no more than ordinary fire duty and so as far as he was aware, no extraordinary danger existed.

At that time he asked me how long our crew would be able to take the work. I replied that if he would see that lunches were brought to us some time during the night that I saw no reason why our crew could not function through the night provided we were relieved during the following morning. Mr. Sieker expressed his satisfaction of this arrangement.

About this time Ranger Clayton arrived on the scene and I met him for the first time. We had a very brief visit because we were quite anxious to get on the job. I was concerned at the present time particularly with seeing that the Foremen understood that all water bags, canteens, and back pack pumps should be filled before leaving Blackwater Creek because the information available at that time did not indicate that water was available in the area into which we were going. Men with back pack pumps were ordered to only half fill the cans because of the stiff climb ahead. The party left Blackwater Creek with myself and Paul Tyrrell in the lead, James Saban was to bring up the rear and we proceeded southeast up an open ridge along the fire of the day before. At about one mile distance we contacted the Park Service crew. Arrangements were made with Mr. Wolcott (Park Service CCC Superintendent) to patrol the line that he had built and send men back to the line being patrolled by men relieved out of the Cody Camp. One spot fire about 35 feet in diameter was passed and we stopped to caution the leader in charge of the men there to get up and do a little work on that spot fire rather than sit and watch it because there were a good many burning stumps in the area. This spot fire was directly opposite the almost dead burn of the day before.

After passing Mr. Wolcott's crew, we proceeded for some distance and were able at various times to observe almost the entire Basin into which we were going. Particular attention was paid to the evidence of spot fires

below the line for future reference after the crew had started to work. At that time no spot fires were seen below the fire line and beyond that portion of the line patrolled by the Park Service men. The fire in general was very quiet and gave every indication that the job of control would be very simple and could be accomplished within a short time. Proceeding on along the fire line, we contacted men of the BPR crew. These men had constructed a remarkably good piece of work, good wide clearing, a very clean trench and were working very rapidly. I stopped a minute with them and told them my plans and that I would come back and contact them later.

We started dropping CCC men for line construction a short distance beyond the BPR crew. I would say not over 200 feet from the beginning of our line construction, we crossed a rocky draw with a small trickle of water. This draw was running northwest. One man was detailed to remain in this draw and build a dam 2 feet high to impound water for back pack pumps and he was to follow up the line as soon as he completed the job. From this point ascending the bank on the opposite slope, we were able to go in a southeasterly direction very near the top of a small ridge through very scattered timber free of duff and down logs. There was very little brush. In fact, fire line construction was very simple at this point. The main fire was only a few feet away to our right. This opening was followed until we reached fires which made it necessary for us to go almost at right angles to that line. Dropping down and crossing another draw which afforded the same conditions on the opposite bank as the first draw. Water was also noted in this second draw, a few feet below where our line crossed it and under a small ridge. I remember calling Tyrrell's attention to this water and remarking how fortunate we were to have water available that far from any pack horses.

This second draw was getting close to timber line and had evidence of either heavy run-off or cloud bursts or water spouts running down. It was within an average of 4 or 5 feet deep and 6 feet wide, and was absolutely swept clean of all inflammable material. This was running in a northwest and southeast direction. I called Tyrrell's attention to the condition of this draw and told him that part of our fire line was already built, that we would use this draw up the country until we had to leave it to corral any fire to the left of it. It was only a few feet to the left of where the fire was burning. At this point the fire was still in the condition that we first noted, no top fires, very little smoke and activity, although there were a number of large spots of trees still unburned, within the main fire. The fire was barely creeping down hill. Our fire line was mostly within a few feet of the blaze. However, we were taking advantage of natural fire breaks in order to complete our line as quickly as possible.

Spot fires to the northeast of the burned over ground made it necessary for the construction of fire trench almost at right angles to the line of the draw, proceeding toward the timber line. Up until this time no wind was in evidence. Almost like a shot out of a gun, there was a heavy wind. It swept through the area in as near as I can determine a northeasterly direction, this carried sparks over the constructed line and below us. I heard a fire roar to the northwest and it appeared to be a considerable distance away. I called to Tyrrell and told him that something was going wrong and that I was going to investigate.

I ran for some distance to the northwest and climbed a rocky point and saw below me a spot fire of considerable size burning to the northeast and around a ridge to the north of us. My impression was that this fire should be immediately taken care of and possibly abandon work on our line in order to do it.

I turned to summon help for this job when there was a decided change in the wind again and the spot fire was swept into the southwest directly into the line of men on line construction. In a few seconds numerous fires appeared below the line at the point where the BPR crew in charge of Bert Sullivan were working and where the water mentioned above was noted. Almost at once it was clearly evident that further attempts at line construction in that area was out of the question. I sent out a call for all men to abandon their work and proceed to the ridge to the northeast. This was approximately three o'clock, P.M.

I then ran down toward the men, found Tyrrell, told him to pass the word both ways, up and down the line, for the men to come onto the ridge. At this time a messenger, David B. Thompson, assistant leader, Tensleep Company, arrived with the following note: "Post, We are on the ridge in back of you and I am going down to the spot in the 'hole.' It looks like it can carry on over the ridge east and north of you. If you can send any men, please do so, since there are only eight of us. Clayton."

Since we were trying to retreat with the whole company, and it was in my judgment certain death for a man to return to the west, this request was not complied with. It was very evident that at the time Clayton wrote this note the wind had not risen and that if he had started to the spot fire mentioned, he would have been down in the canyon, out of sight of the fire and could not have known the exact conditions that followed.

After sending Tyrrell to warn the men, I climbed the ridge to the northeast to where I could observe the spot fire more closely. It seemed to take a long time for the men to straggle up the hill out of the canyon. My recol-

lection is that the BPR party was among the first to reach the bare ridge and in the discussion with Mr. Sullivan, we agreed that provided the crew got out in the next few minutes to where we were, that it would be an easy matter for us to retreat down the ridge to the northwest and just north of the spot fire that was doing the damage and get beyond all fire without any question.

We walked the ridge and called and tried to impress upon the boys the seriousness of the situation and their need for haste. By the time Mr. Tyrrell reported all the men out of the hole that he was able to get any trace of or notify, the wind had changed several times. Spot fires were in evidence north of the ridge we were on. The main fire was traveling in a northeasterly direction toward timber line. All possible chance of escape was cut off to the north and west. The area in the vicinity of the water hole was all ablaze, and consulting Mr. Tyrrell, BPR leader, and Bert Sullivan, we agreed that our only possible chance of escape lay in the direction of the timber line. We immediately ordered all men to drop all heavy tools, back pack pumps, and carry only lanterns, the light lady shovels, and Pulaski tools, and make all possible speed up the ridge in a southeasterly direction to the timberline.

When we reached the last park, almost at timber line, the fire had entered the short neck of timber between us and timber line. In traveling up the ridge toward timber line, Mr. Sullivan and the men of the BPR took the lead. Mr. Tyrrell and myself were in the rear of the column, urging the boys on. Sullivan was requested to size up the situation as he went and try by all means to get above timber line. When we reached the park below timber line and found we were cut off, the men were nearly exhausted from the climb out of the canyon. At this time the canyon to the north was still open to us but there was an abrupt drop from the top of the ridge for a distance that could not be determined on account of the cover. We could see a large open rock slide to our northeast and a possible exit above timberline through a gap but after an examination of the crew, it was decided against taking a chance on going into that hole on the assumption that a spot fire might show up and that we had no means of knowing about and possibly make a trap.

We were able to gain a few minutes' rest on this rock ridge, or open park, before the timber to the south crowned. By climbing down the steep north slope of the ridge we were afforded fairly good protection from this crown fire from the south with the exception of sparks dropping and setting fire to our clothes. The boys showed considerable restlessness at this time and we were continually warning them to lie still, not disturb any

rocks that would roll on ayone and make him lose his footing, and to watch each other's clothes for fire.

This blast produced spot fires in the canyon just mentioned, to the north of us, which showed us that our judgment was right in staying out of that trap. Sullivan and Tyrrell and myself crawled to the top of the ridge and all agreed that that crown fire was possibly the thing that was going to save us because if the wind held in its present direction and didn't sweep around in the canyon to the north that that first burn would be cool enough for us to retreat into when the other would let go. As soon as we were convinced that the smoke from this fire was not dense enough to cause trouble with breathing, we moved the men from the north side of the ridge over the south side, explaining to them what was likely to happen and what they should do when it did happen. We cautioned them and we told them that we might have a pretty tough time but if we stood a chance anywhere in the country it was there and regardless of what happened they were to stand hitched and lie flat on the ground. It was emphasized that they would have no hope of reaching safety through the burn and apparently they agreed. But a very few minutes elapsed between our move and the crowning of timber to the northwest, down to the ridge and in the canyon to the north. The park was swept by a sheet of flame and I have no way of estimating its duration. Nearly all the boys grew panicky and instead of lying down as instructed, a good many of them stood up and ran to the edge of the park, turned and came back. Some of the boys did not listen to any orders, instructions or cautioning and were insistent upon standing up and saying their prayers.

BPR men, especially Bert Sullivan, were of great value in aiding with the managing of these men and keeping them controlled as much as they did. After the first blast of flame swept the park I do not believe there were over one more short interval that we endured flames. For a considerable period the smoke was so dense that it was very doubtful if some of the men would survive and by this time though, we had convinced them that their only chance was to keep their noses to the ground. The wind was shifting so often that we were soon able to get fresh air at regular intervals and the danger was somewhat lessened. In perhaps an hour the smoke had lifted until we were quite safe from that source and in taking stock of our injuries and conditions generally it was noted that at least one BPR man was missing and one CCC crew leader. There was no way of knowing which way they had gone and it was folly to my mind to search for them in the blaze. We kept this information to ourselves because we thought if the boys learned of it they might grow more unmanageable.

For perhaps an hour after we received our burns the big job was to hold the crew in this park. They were assured that all possible help would be forthcoming as soon as the burn-over cooled, that they could be sure that as soon as we could get through the burn in reasonable safety, some of us would go for help.

Mr. Tyrrell was so badly burned that he was no longer of any help. He was told to lie still and stay on the ground. At sundown, I took Mr. Sullivan and one or two of the BPR men who did not seem to be burned badly and we proceeded slowly down to the fire to try to determine if it was possible to make the trip. After getting into the burn a short distance we found that the ground was quite cool at that point due to its not having any great amount of duff to burn.

We could hear someone calling off in the direction of the fire line we had attempted to construct. We could not get any intelligent answer so concluded that someone must be in danger and that if he was in a condition to enable him to call that surely the smoke was not bad enough but what we could manage. I then sent Mr. Sullivan back with instructions to hold these men on the ridge, light the lanterns when dark came and answer any call that he might hear. The other man, whose name I did not learn, proceeded with me in the direction of the call in the fire burn. We were very near the line when we found a boy lying on his back, badly burned, calling for help and wanting water. We knew that we were within a short distance of the water that we had passed on the way in and the BPR man had a water bag with him so he was left to get some water and do what he could for this boy. I showed him the general direction that I intended to take through the burn and told him that I was going for help. I went only a short distance when I met Assistant Supervisor Kreuger on his way in. I briefly outlined the condition of the men and what was needed to get them out and he replied that he would go back with me through the burn and get help.

After meeting Kreuger we had traveled only a short distance to the west when we observed a pile of bodies in a small draw. We stopped for a brief pause and thought we could count 7. There were back pack pumps with these men. (This is presumed to be the water course where the dam was built on the way into the fire.) Kreuger and I ran through the burn west to the open ridge along side the burn of Friday and went down the trail leading into Blackwater Creek. About a quarter of a mile before reaching Blackwater Creek we met Supervisor Sieker with a party of boys, carrying bedding and lunches on the way in. Supervisor Sieker was clearly relieved when he learned that there were forty or so men on the peak.

I briefly told him the condition of the men and that I thought possibly all except three or four could walk out. I was sure that Foreman Tyrrell and one or two others would have to be brought out on stretchers. Supervisor Sieker told me that they had arranged for doctors, medicine and medical help to be sent in and from the looks of this party and their equipment I would say that he had done a very excellent job of preparing for an emergency that he was not even informed of. He instructed me to continue on to Blackwater Creek where an Army Doctor was available to treat my burns.

To the best of my recollection, one BPR man and one CCC crew leader ran out through the fire from the park. The leader I saw in the F-24 hospital in the ward on Sunday morning. This boy told me that he was the one who broke and ran when the fire hit us.

U. J. Post,
District Forest Ranger.

August 27, 1937.

DEATH COMES TO LLOYD G. HORNBY

On the same day of the catastrophe on the Shoshone, Lloyd G. Hornby died from overexertion on a fire on the Clearwater National Forest in North Idaho. While on his way to a lookout station near the fire he pitched forward between words of a sentence. The men with him thought he had fainted, but it was soon apparent that the end had come from heart failure.

Hornby was just completing his first round of the National Forest Regions after six months in his assignment as Fire Control Specialist directing the recheck of fire planning on all National Forests. His death is not only a grief to his many friends, but pretty well wrecks all plans for National leadership and coordination in the three-year fire control planning project. No successor has been selected.

MAN-CAUSED FIRES IN RELATION TO NUMBER OF VISITORS

Division of Fire Control

Washington, D. C.

Man-caused fires on the national forests must obviously be started either by people visiting the forests or by residents living within them. In searching for an understanding of the why of such fires it is worth while to consider variations in number of visitors per fire in different parts of the country. These variations are shown in the accompanying tables.

While no great degree of accuracy should be attributed to the statistics on number of visitors, the gross variations are indicators of what happens in different parts of the country and under varying systems of fire prevention. Promising leads for further study may be found in these gross variations. There is no need to try to draw dubious inferences from small differences in the figures. A few of the more significant comparisons are worth mentioning. All figures on number of visitors are for the fiscal year 1936. In the following comments the figures on number of visitors per fire are all from the second visitors' column—"excluding those merely passing through."

The Pike National Forest attracts attention at once. While fuels are light on the Pike, there is plenty of material in which fires could start and spread. Although summer rains are normal in normal years, it is, nevertheless, a dry country. Mean humidity is low. The number of days per annum in which fires will start and run is probably higher than average for the national forests. *In the face of these conditions only 1 person out of 232,737 is responsible for the start of a reportable fire.* If this figure is discounted 50 per cent, then 1 person out of 116,368 starts a fire. This reduced figure is higher than the next largest—1 fire per 94,292 visitors on the White Mountains, where the climate is relatively favorable.

Part of the explanation is, perhaps, that the total number of man-caused fires is low on both forests. As the number of fires approaches zero the number of visitors per fire loses its significance—or at least assumes a different sort of significance. But the theory that number of visitors per fire means less as number of fires approaches zero has a significance of its own. If after reasonably effective prevention is attained, large increases in number of visitors are unimportant in their influence on number of fires, this is a source of encouragement for prevention planners. Perhaps an increase in number of visitors carries its own safety factor.

There is a challenge in the comparison of the Angeles with many other

forests. There are few safety factors on the Angeles. Days per year in which fires will start and run must be relatively high. Its fuels are of the "tinder box" sort. Low humidity and high fall winds are characteristic phenomena. There is much human use of the forest, which is equivalent to the presence of a large resident population, a much more important factor than visitors in the Gulf States. One fire for each 37,711 visitors on the Angeles stands out as tangible evidence of what can be accomplished under certain conditions.

What can be the explanation of the great difference between the Angeles figure and those for the other southern California forests? How did the Angeles get that way? May the other southern California forests be expected to follow suit? What is there in the way of theory and practice which might be transferred from the Angeles to the Shasta, the experimental fire forest, with its man-caused fire for every 696 visitors?

Close reading of all the man-caused fire figures by forests, together with the corresponding figures on visitors per fire, suggests that number of visitors may easily be over appraised as an explanation of the number of man-caused fires. There are blocks of such figures from which the first inference would be that number of fires vary more directly with area than with anything else. The curious Black Hills and Harney figures point that way. Fuels and weather must be more than usually uniform on these two units. The Black Hills organization could probably prove that it is not because of less prevention interest and effort on that forest than on the Harney that the Black Hills has one fire per 447 visitors.

The new units in Eastern Regions must be regarded as in a class by themselves. Time (but not too much time) must be allowed for getting a response from large resident populations to national forest influence for prevention. But the figures for some of the older eastern units leave something to be desired. For example, if the figures of one fire for each 102 and 60 visitors, respectively, on the Ouachita and Ozark Forests are explained by referring to the large resident populations, then what happens to the reputation these forests have had for success in controlling the fire-starting habits of local people? Two hundred and twenty-five fires for the Ouachita and 265 for the Ozark are not too encouraging. The new areas added to each forest have no doubt had an influence on the figures, but a glance back through the record for the years prior to recent additions shows a disheartening number of man-caused fires.

Man-Caused Fires in Relation to Number of
Visitors to National Forests During C.Y. 1936
(Numbers of Visitors are for F.Y. 1936)

Region State & Forest R-1	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Montana			
Absaroke	3	36,833	7,833
Beaverhead	4	13,025	7,225
Bitterroot	9	8,711	3,056
Cabinet	58	3,007	376
Custer	13	2,116	870
Deerlodge	28	17,707	2,664
Flathead	24	8,249	770
Gallatin	12	41,433	3,692
Helena	17	12,448	1,507
Kootenai	43	734	294
Lewis & Clark	15	6,380	3,280
Lolo	24	2,460	815
Total (or average)	250	8,127	1,430
Idaho			
Clearwater	7	641	624
Coeur d'Alene	30	1,205	608
Kaniksu	24	2,233	1,050
Nezperce	21	452	229
St. Joe	57	560	322
Total (or average)	139	976	511
Total (or average) R-1	389	5,572	1,101

Region State & Forest R-2	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Colorado			
Arapaho	4	164,031	14,507
Cochetopa	14	18,357	1,500
Grand Mesa	3	18,165	14,670
Gunnison	4	6,747	2,095
Holy Cross	7	18,323	4,584
Montezuma	7	36,125	9,621
Pike	9	528,903	232,737
Rio Grande	7	21,714	10,671
Roosevelt	6	126,697	34,652
Routt	5	13,794	3,534
San Isabel	2	43,645	29,208
San Juan	8	5,438	1,200
Uncompahgre	4	5,350	2,004
White River	2	42,982	9,568
Total (or average)	82	89,820	33,182
Nebraska			
Nebraska	1	6,090	740
South Dakota			
Black Hills	34	3,976	447
Harney	46	3,686	2,805
Total (or average)	80	3,809	1,803
Wyoming			
Bighorn	10	21,904	4,874
Medicine Bow	16	20,644	4,437
Shoshone	2	33,802	13,188
Washakie	3	7,987	2,120
Total (or average)	31	20,674	4,919
Total (or average) R-2	194	42,871	15,559

Region State & Forest R-3	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Arizona			
Apache	12	7,375	958
Coconino	57	3,825	667
Coronado	19	6,739	5,849
Crook	8	58,415	4,621
Kaibab	46	31,377	399
Prescott	36	20,742	1,186
Sitgreaves	25	1,456	336
Tonto	9	14,935	8,043
Total (or average)	212	15,391	1,601
New Mexico			
Carson	11	14,084	1,605
Cibola	25	9,872	3,280
Gila	13	9,308	1,615
Lincoln	10	35,798	4,088
Santa Fe	4	24,500	9,250
Total (or average)	63	15,535	3,128
Total (or average) R-3	275	15,424	1,951

(1) Where Forest is located in more than one State, figures are included in State in which greater portion lies,

(2) Number of visitors are for F.Y. 1936.

(3) Number of fires are for C.Y. 1936.

Man-Caused Fires in Relation to Number of
Visitors to National Forests During C.Y. 1936
(Numbers of Visitors are for F.Y. 1936)

Region State & Forest R-4	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Idaho			
Boise	57	374	280
Cache	40	6,167	3,240
Caribou	0	(28,780)	(20,350)
Challis	14	1,791	674
Idaho	49	829	149
Lemhi	3	10,390	6,623
Minidoka	10	3,745	7,513
Payette	27	7,423	1,665
Salmon	14	446	389
Sawtooth	14	2,583	1,808
Targhee	27	8,456	2,967
Weiser	45	1,663	352
Total (or average)	300	3,257	1,322
Nevada			
Humboldt	12	627	358
Nevada	1	81,470	22,930
Total (or average)	13	6,845	2,095
Utah			
Ashley	3	11,050	10,110
Dixie	9	12,038	7,667
Fishlake	3	70,790	28,653
La Sal	0	(4,440)	(2,800)
Manti	1	48,400	48,400
Powell	2	52,850	2,600
Uinta	5	41,606	16,428
Wasatch	32	18,179	9,527
Total (or average)	55	23,676	11,235
Wyoming			
Teton	0	(207,640)	(40,000)
Wyoming	9	3,942	2,381
Total (or average)	9	27,013	6,826
Total (or average) R-4	377	6,927	2,926

Region State & Forest R-5	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
California			
Angeles	35	198,118	37,711
Cleveland	33	19,774	4,630
Eldorado	60	6,657	2,341
Inyo	11	31,096	9,743
Klamath	73	321	211
Lassen	68	5,266	1,121
Los Padres	25	93,224	3,992
Mendocino	31	655	506
Modoc	75	3,835	403
Mono	11	16,291	13,200
Plumas	163	706	338
San Bernardino	82	89,358	8,984
Sequoia	33	15,108	5,278
Shasta	128	9,909	696
Sierra	47	11,435	2,298
Stanislaus	38	12,474	2,816
Tahoe	140	10,250	1,893
Trinity	54	1,391	368
Total (or average) R-5	1,107	21,010	3,305

Region State & Forest R-6	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Oregon			
Deschutes	40	5,062	1,305
Fremont	21	873	506
Malheur	45	315	268
Mt. Hood	56	18,554	4,983
Ochoco	25	604	196
Rogue River	24	5,464	1,658
Siskiyou	92	4,213	503
Siuslaw	104	11,704	3,807
Umatilla	54	905	583
Umpqua	20	2,577	2,023
Wallowa	21	2,033	1,033
Whitman	97	571	206
Willamette	31	5,086	2,378
Total (or average)	630	5,367	1,632
Washington			
Chelan	19	1,063	956
Columbia	11	43,350	2,138
Colville	40	636	342
Mt. Baker	22	3,666	3,568
Olympic	14	6,118	4,495
Snoqualmie	33	43,465	5,970
Wenatchee	23	105,384	5,782
Total (or average)	162	28,068	3,252
Total (or average) R-6	792	10,010	1,963

(1) Where Forest is located in more than one State, figures are included in State in which greater portion lies.

(2) Number of visitors are for F.Y. 1936.

(3) Number of fires are for C.Y. 1936.

(4) In Region 4, for Caribou, La Sal and Teton total number of visitors is given.

Man-Caused Fires in Relation to Number of
Visitors to National Forests During C.Y. 1936
(Numbers of Visitors are for F.Y. 1936)

-3-

Region State & Forest R-7	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
New Hampshire			
White Mtn.	5	916,791	94,292
Pennsylvania			
Allegheny	31	44,562	2,114
Vermont			
Green Mtn.	3	140,106	1,923
Kentucky	469	26	(.4)
Cumberland			
Virginia			
Geo.Washington	51	17,170	1,417
Jefferson	114	440	112
Total (or average)	165	5,611	515
W. Virginia			
Monongahela	35	9,429	857
Total (or average) R-7	708	10,810	929
R-10			
Alaska			
Chugach	17	282	135
Tongass	23	3,065	2,561
Total (or average) R-10	40	1,882	1,520
TOTAL (OR AVERAGE) WESTERN REGIONS	3,174	15,312	3,264

Region State & Forest R-8	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Alabama Forests	28	732	332
Arkansas			
Ouachita	225	1,078	102
Ozark	265	124	60
Total (or average)	493	559	79
Florida Forests	105	2,442	265
Georgia			
Chattahoochee	53	3,012	927
Louisiana			
Kisatchie	796	12	8
Mississippi Forests	897	1,020	7
North Carolina			
Croatan	86	241	9
Nantahala	117	1,564	453
Pisgah	121	4,394	581
Uharie	16	?	?
Total (or average)	340	2,163	365
South Carolina Forests	263	1,023	92
Tennessee			
Cherokee	125	7,245	625
Texas Forests	709	17 (3)	17
Total (or average) R-8	3,809	934	99
TOTAL (OR AVERAGE) R-7-8-9	8,490	2,483	180

Region State & Forest R-9	Total man-caused fires	Average Number of Visitors per Fire: Including those merely passing through	Average Number of Visitors per Fire: Excluding those merely passing through
Illinois			
Shawnee	262	3,944	266
Indiana			
Hoosier	115	14,510	14
Michigan			
Hiawatha-Marquette	97	6,976	409
Huron	31	5,492	1,089
Manistee	216	2,537	106
Ottawa	59	4,084	1,202
Total (or average)	403	3,819	415
Minnesota			
Chippewa	101	4,174	726
Superior	68	4,516	890
Total (or average)	169	4,312	792
Missouri			
Clark	1,716	134	14
Gardner	1,082	946	15
Total (or average)	2,798	448	15
Ohio			
Wayne	67	51,014	268
Wisconsin			
Chequamegon	41	3,173	645
Nicolet	118	823	197
Total (or average)	159	1,429	313
Total (or average) R-9	3,973	2,443	125
GRAND TOTAL (OR AVERAGE)	11,664	5,974	1,020

(1) Where Forest is located in more than one State, figures are included in State in which greater portion lies.

(2) Number of visitors are for F.Y. 1936.

(3) Number of fires are for C.Y. 1936.

(4) In Region 8, for Texas Forests, no number of visitors passing through is given.

TEMPORARY TOWERS FOR VISIBLE AREA MAPPING

By R. M. Beeman

Junior Forester, Jefferson National Forest

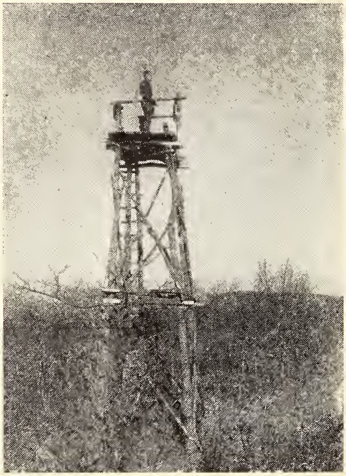
The primary data in the formulation of a detection plan are visible area maps for every possible lookout point in the district. Unless topographic sheets are quite accurate and the point to be considered is an abrupt peak, a visible area map made in the office by profiling will prove decidedly unreliable. Ordinarily, the map must be drawn in the field, and satisfactorily accurate field mapping involves use of the plane table.

The mapper requires a relatively unobstructed view in all directions. Often, however, a point will be so densely covered with timber or brush that even a combination of several set-ups will not provide complete coverage. When this is not obtainable from the ground, the following alternatives are suggested:

First, one or several trees may be climbed. In the East this can often be accomplished without spurs. Where a satisfactory map can be obtained by its use, this method is desirable, as it involves no damage to either timber or aesthetic value. The difficulty of maintaining a map board in a level, oriented position and of using an alidade, while perched precariously in a waving tree top, precludes accuracy. An unusually skilled and experienced man can produce a good sketch under these conditions. However, when use of the plane table checked by duplicate mapping by an experienced man has proved only about 85 per cent correct, it appears desirable, when practicable, to provide the mapper with ample assistance. The final detection plan can be only as reliable as the visible area maps upon which it is based.

Two methods facilitating use of the plane table have been employed on the Jefferson National Forest: (1) cutting the timber, and (2) building a temporary wooden tower. The former is applicable if the timber value is low, and if the point in question rises sharply above the surrounding terrain. On the newer purchase units it often involves obtaining permission from the owner or owners before cutting. Sometimes, even though the trees have little value for timber, permission is not granted. Also, a point on a level ridge or in gently sloping terrain would require an enormous amount of clearing. Despite these limitations, cutting has proved applicable to a limited extent: The mapper is accompanied by a four- or six-man felling crew which clears out such areas as he directs. By clearing the least obscured sector first, mapping starts early in the day, and one trip to the point is sufficient.

District Ranger J. N. Van Alstine has developed a wooden tower which has proved eminently satisfactory for plane-table visible area mapping in country characterized by level ridges covered with scrubby oak and hickory. The tower (see illustration) is constructed of material cut in the vicinity. It is formed of 4 legs—one of which is a living tree, topped and trimmed—horizontal and vertical braces, a plank platform 5 feet square, a railing 3½ feet above the platform, a ladder up alongside one leg, a fifth, minor leg serving as the other member of the ladder, all put together with 60-penny nails. Use of a living tree as one member adds to rigidity and durability. The plank platform and railing enable the mapper to set up his tripod and proceed as on the ground. Supplies to be carried in are 2-inch plank for platform, nails, axes, hammers, crosscut saws, tree climbers, pulleys, and rope.



A crew of 10 CCC men can erect such a structure in 2 days. Greatest height to date is 33 feet. Increased height involves decrease in stability and entails handling increasingly heavier pieces; over 40 feet would prove impractical for a structure of this type. Use of the tallest straight oak or hickory at the highest point of the mountain as one leg usually insures sufficient height; if it does not, a tower on each side of the crest may be necessary.

The cost of constructing such a tower is: labor and supervision, about $40; materials, negligible. If the first described method, that of cutting the timber, is employed, costs will obviously be proportioned to the amount to

be felled. The largest crew used on the Jefferson was 6 men, as the mapper served also as foreman, and both clearing and mapping were completed in one day. The cost was the daily wage for 6 men, or about $9. The timber-cutting method is apparently the cheaper, and is recommended upon two conditions: that the value or extent of the timber is not so great as to make costs exorbitant, and that it is not anticipated that the peak in question will be used as a secondary lookout within the next 5 years. Bearing these two qualifications in mind, the detection planner will no doubt find that tower construction is sometimes indicated.

A network of these temporary towers, in addition to providing facility for visible area mapping and thus the foundation for a sound detection plan, will also serve during hazy weather as the nucleus for the secondary lookout system. The 5-foot square plank platform is ample for installation of a simple alidade and its manipulation by the observer, although high winds may necessitate occasional check on orientation. Lightning protection will probably prove desirable, and lack of shelter will be a handicap during rough weather. For secondary use, however, this type of structure appears to merit consideration.

POWER LINE FIRES IN REGION 5 AND THEIR PREVENTION

By C. A. Gustafson

Assistant Chief, Fire Control, Region 5

During 1935 the Forest Supervisors of Region 5 were requested to send in a report on all fires attributed to power lines during the past several years. The Plumas Forest submitted an 18-year record; Los Padres (formerly Santa Barbara), Sequoia, Sierra, and Trinity Forests a 14-year record; the Angeles, Lassen, San Bernardino, and Stanislaus a 10-year record; the Tahoe a 7-year record; and the Eldorado and Shasta a 4-year record. No fires from power lines had occurred on the Modoc, Mono, Inyo, Mendocino, Klamath, and Cleveland Forests. The report is up to and including the season of 1934.

Following is the number and area of fires attributed to different phases of power line failures:

Cause	Number of Fires	Per Cent of Fires	Area Acres
Flashover	3	6	12
Fallen poles or towers	2	4	37
Power pump and telephone line	1	2	....
Broken power lines	9	18.5	22,484*
Faulty insulation	8	16.5	300
Fallen trees or snags	13	27	3
Birds	2	4	....
Improper clearance	5	10	3,553†
Current turned on by mistake	2	4	....
Power shorts	2	4	....
Burning fuses	1	2	640
Blasting	1	2	....
Total	49	100	27,029

Out of a total of 26,034 acres attributed to broken transmission lines, 22,180* acres was the result of the Lower Sesar fire on Los Padres (Santa Barbara) Forest during 1929.

Out of a total of 3,553 acres attributed to improper clearance, 3,550† acres was due to the Brown Mountain fire on the Angeles during 1934.

Most transmission lines operate under licenses from the Federal Power Commission. The licenses issued for their lines generally have standard stipulations in them which empower the Forest Service to exact certain fire preventive measures from the operating company for lines traversing Government lands. These stipulations when briefed bring out the following factors which can be interpreted as tools to be used by the Forest

Service in requiring the power companies to operate their lines in such a way that the possibilities of fires starting are reduced to a minimum:

1. Licensee shall clear and keep clear to adequate width its lines on United States land to the satisfaction of representatives of the Federal Power Commission.

2. Licensee is liable for injury to or destruction of buildings, roads, lands, or other United States property occasioned by the construction, operation, or maintenance of the project.

3. Licensee shall do everything reasonably in its power, and require its contractors to do everything independently and upon request of the United States representatives, to prevent and suppress fire on or near lands occupied under license.

4. Licensee shall maintain projects in adequate, efficient, and safe operating condition.

Referring back to the past history of fires due to power line occupancy, the prevention of fires may be accomplished in the following manner:

Fires Due to Flashovers

Fires from flashovers are the result of transmission lines swinging together when the spans are too long. In such cases additional towers or poles should be installed in order to reduce the length of span. This can be required under stipulations 3 and 4.

Fires Due to Fallen Poles or Towers

When fires occur because of fallen wooden poles, usually the pole has rotted at the ground line. Forest officers during the yearly inspection of transmission lines should carefully observe the poles near the ground line, noting which poles have rotted to a considerable extent, and report their findings to the power company.

Failure of steel towers generally occurs only during winds of extraordinarily high velocities or because the design of the tower is not in keeping with the conditions under which it is expected to operate.

With regard to both wooden poles that have rotted at the base sufficiently to constitute a hazard and poorly designed towers, licensees can be required to replace them under stipulations 3 and 4.

Fires Due to Power Pump and Telephone Line

Fires due to power pump and telephone line are either the result of poor maintenance or improper construction. If after examination of the line such conditions are found, the licensee can be required to remedy them under stipulation 4.

Fires Due to Broken Power Lines

The design and subsequent construction of transmission lines take into account the necessary mechanical strength of the line to withstand the weather conditions prevalent in the locality of the line. Possibility of a coating of ice on the conductor and wind pressure to a large extent determine the mechanical strength necessary in the line.

Where conductors have been breaking with more than very occasional frequency it is evident that the design of the line will not withstand the loading conditions which obtain in the locality. In such cases, upon proper showing, the licensee can be required, under stipulation 4, to reconstruct its line so as to make it safe under existing operating conditions.

Fires Due to Faulty Insulators

Insulators have probably the highest depreciation rate of all equipment used in transmission lines. Most companies test insulators on their lines once every five years. If fires have been occurring from this cause at more than rare intervals, forest officers should check to determine if the company has tested its insulators recently. If not, the licensee can be required, under stipulations 3 and 4, to test insulators and to replace those found to be faulty.

Fires from Fallen Trees or Snags

Stipulation 1 requires the licensee to keep clear to adequate width its lines on United States lands to the satisfaction of a representative of the Federal Power Commission.

No uniform policy can be established with regard to clearing because of the many variations in cover and topography along power lines. All forests, however, should make an annual survey, preferably with a representative of the operating company, to determine the clearing requirements necessary. They should look for insufficient clearance that might result in fires starting.

Clearing around poles should be of sufficient radius to catch falling insulators. Clear 10 feet in radius for lines of 11,000 volts and less, and a minimum of 20 feet around higher voltage lines.

Need for complete clearing of right-of-ways to specified widths throughout the entire distance across national forest land should be required only when the forest officer can show it is a reasonable and worth-while requirement. The width should be kept as low as will meet the needs.

Fires Caused by Birds

Little can be done to reduce fires caused by birds. Some companies have

installed bird guards on their transmission lines. However, the stipulations do not generally contain this requirement.

Fires from Improper Clearance

This type of fire is entirely due to faulty design or inadequate clearing. On national forest land the licensee can be required to remedy the fault under stipulations 1 or 3.

Fires Due to Current Turned on by Mistake

This type of fire is entirely inexcusable from the standpoint both of safety to life and fire protection. Where such a fire occurs it should be brought to the attention of the licensee, since the power companies are as anxious as the Forest Service to prevent such errors.

Fires Due to Power Shorts

Several factors may be involved in power shorts, such as faulty insulators, fallen trees, improper clearance, etc. Corrective measures can be required under the stipulations set forth for these causes.

Fires Due to Burning Fuses

Fires caused by burning fuses can really be considered inexcusable, because it is very poor practice to use the open type of fuse where there is a fire hazard. When inspections of transmission lines are made, forest officers should be on the alert to discover the use of such fuses. In localities having a fire hazard, a licensee, under stipulations 3 and 4, can be required to use the enclosed type of fuse of non-inflammable nature where it will function.

Fires from Blasting

Blasting on Forest Service or other construction projects within the forest protection area should be done with extreme caution, particularly when in the vicinity of transmission lines. Continued vigilance on the part of forest officers will do much to reduce possible fires from this cause.

General

It can readily be seen, when studying transmission line fires, that thorough inspection of all lines traversing national forest areas must be made annually, followed with a written report to the company giving the measures to be taken to bring their lines up to the operation standards that will prevent fires from starting.

RAILROAD FIRES

By C. A. Gustafson

Assistant Chief, Fire Control, Region 5

Railroad fires have been a constant threat to national forest protected areas in Region 5 ever since national forests were established. The trend of these fires, as shown by the following figures, does not indicate that prevention efforts have paid very big dividends.

The number of fires attributed to railroads are 21, 22, 12, 25, 47 and 71, respectively, for the years 1931 to and including 1936, or a total of 198 fires from this cause for the six-year period.

The area for the same period is 760, 90, 241, 2,203, 781, and 22,854 acres, with a damage figure of $416, $20, $206, $9,312, $758, and $38,704, respectively.

A breakdown of railroad fires into specific causes shows, in order of importance, that brake shoes, engine sparks resulting from indiscriminate sanding, discarded burning waste, fusees, and right-of-way burning are responsible for most of these fires.

When studying these causes with the view of effecting specific prevention measures, the following data are noted:

Fires Caused by Brake Shoes

It is found that most, if not all, of the brake-shoe fires occur on down grades. The "tight" schedule under which the trains operate, the large tonnage of both the passenger and freight trains, and the excessive grades (up to 2.8 per cent) necessitate heavy braking to slow down for the many curves in the canyons, or to stop when it is necessary to "pull" into a siding. This heavy braking causes the tires and brake shoes of the locomotives and the wheels and the shoes of other rolling stock to become so overheated that red-hot material, weighing as much as 2 or 3 pounds, sloughs off. Many specimens of brake shoe tire, and wheel scale have been found at the point of origin of a fire, in some instances as far as 16 feet from the outside rail. The fusion of this scale, which could occur only when the metal was so hot that it would "run," forces us to believe that numerous fires have been caused by this hot material.

Removal of all inflammable material for a safe distance from the track will eliminate this type of fire.

Engine Sparks (Indiscriminate Sanding)

Engine sparks seem to be a constant cause of fires. My three-years' experience as a locomotive fireman leads me to believe that these fires are probably caused by a process known as fine sanding of the engines while running. Fires originating in this way occur on the upgrades or when the engine is under heavy labor, thereby causing sufficient draft through the stack to draw the sand from the firebox through the boiler flues. An engine is rarely sanded on down grades unless it is put under a full throttle to create sufficient draft through the stack.

Clearing to make sanding safe any place along the right-of-ways is economically impossible, since the distance to be cleared is too great; also it is entirely unnecessary. There are several things, however, which may be done to prevent fires from this cause:

1. Proper equipment of locomotives with spark arresters and periodical inspection to make sure they are in good operating condition.

2. Survey, in company with local railroad officials, to determine where sanding is usually necessary and provide for changing such locations if the cost of reducing the hazard is too great.

3. Make plans with the officials at the time of survey to have the hazard reduced along sanding lanes. This should be done to a distance of 200 feet each side of the outer rail.

4. Work to get railroad officials to issue instructions to their engine men to "sand" only at the approved locations.

5. Get the company to mark the location where sanding may be done so the engine men can readily recognize them and clean the engine flues when passing through these lanes.

Fusee Fires

Fusees are often lighted and thrown from moving trains as a warning for trains following. When so thrown they very often fall in the center of the track, but sometimes they roll or bounce to the side, where the flames come in direct contact with dry grass or other fuel and ignite it. The old type of fusee was equipped with a spike which permitted it to be stuck upright on a tie, thereby greatly reducing the danger of fire, as the "off-fall" from a burning fusee will not usually set a fire when it is in the upright position.

In my opinion, based on observation and experience, the spike-type fusee would materially reduce the possibility of fires from this cause, since, as a conservative estimate, I should say that at least 50 per cent of them would

stick upright if properly thrown from moving trains, and would always stick if placed by a flagman on the ground. Many railroads at the present time, however, are using a spikeless type of fusee which was recently approved and adopted by the American Railroad Association as standard.

Four means of preventing fires from this cause are:

1. Hazard reduction work along the railroad right-of-ways.

2. Using the spike-type fusee.

3. Written instructions by railroad officials to their men to be careful in the placement of the fusee.

4. Contacts with Railroad Brotherhood members to secure their cooperation with respect to fusees.

Fires from Discarded Lighted Material

Fires caused by discarding lighted material, such as burning waste, cigarettes, matches, etc., and, in the case of coal-burning locomotives, kicking from the engine deck hot clinkers that have been pulled from the firebox, are really inexcusable. Forest officers should seek to get railroad companies to issue positive and mandatory instructions to their employees forbidding this practice. In this connection forest officers should also arrange to appear before various Brotherhood meetings from time to time for the purpose of impressing their members with the necessity for their full cooperation in this connection.

Right-of-Ways Hazards Fire

Fires starting from burning right-of-ways are usually the result of:

1. Inadequate advance planning by the railroad companies.

2. Insufficient manpower to handle the work.

3. Inadequate, or lack of, patrol.

4. Burning during period of high hazard.

5. No inspection of burning operations prior to or during burning by forest officers.

6. Insufficient equipment.

To make sure that fires do not start from burning right-of-ways, forest officers should check all the points listed and take such steps as their inspection shows to be necessary to prevent the possibility of fires following this work.

In summary, the forests of Region 5 are taking the following steps to reduce fires caused by the operation of railroads.

1. When new construction is on national forest land or where the projection of new trackage is contemplated, fire prevention stipulation as to

hazard reduction, equipping machines with spark arresters, etc., are written into the permit.

2. Railroad crews are being dispatched to suppress railroad fires whenever possible.

3. If Federal property is damaged, or where the Forest Service expends Federal funds to suppress such fires, adequate trespass settlement is asked of the railroad company.

4. Annual surveys of hazards are being made in advance of the fire season, on railroad right-of-ways by mile posts, with specific recommendation of control work to be done and estimate of cost to the company. This survey is submitted to the company officials for action, with definite recommendations as to plans, dates, etc., in advance of the fire season and previous to the submission of budget estimates by the railroad maintenance department. Technical advice is given and incidental supervision on actual jobs is planned by the Forest Service.

5. Recommendations to the company regarding adequate spark arrester installation, sanding lanes, etc., are made and followed up to see that they are carried out.

6. Meeting with railroad train and engine men and company officials to secure their cooperation in preventing fires.

The work being done by the forests will, we feel, bring results. One company, this spring, budgeted $6,000 for hazard reduction, something it never did before; while another company has set up sufficient funds to employ a 35-man hazard reduction crew equipped with two trail builders and other necessary tools. One other company plans on completing the major track maintenance job in a hazardous canyon prior to the fire season.

We feel that, as the season advances, the efforts of Region 5 in reducing railroad fires will bear fruit and that next fall the records will show a smaller number of such fires.

LAW ENFORCEMENT AS A PREVENTION MEASURE

By G. L. Fraser

Fire Prevention Officer, Region 5

Law enforcement has taken its place as an essential part of the fire prevention program in Region 5. The effectiveness of our efforts are particularly reflected in the reduction of disastrous incendiary fires occurring annually on national-forest land. The records show a steady decrease from 134 incendiary fires in 1931, with an area of 50,440 acres burned and damage estimated at $179,030, to 28 incendiary fires in 1936, with an area of 1,688 acres burned and damage estimated at $5,803.

This marked reduction is not solely attributable to law enforcement. There are many other contributing factors, *i. e.*, improved detection, communication, and transportation facilities, improved training of fire-fighting forces, improved fire-fighting equipment and, last but not least, the almost exclusive use of CCC labor for fire-fighting purposes. CCC labor has in no small degree discouraged the setting of fires to create jobs.

It is regrettable that no yardstick has yet been devised by which we can accurately and independently appraise the exact prevention value derived from each of the factors mentioned. However, the effect of law enforcement has become increasingly apparent by the changed attitude of the incendiary elements in the mountainous areas. Loud and boastful talk about malicious burning is no longer heard. Rarely do we now meet with the statement from suspects in fire cases: "You can't prove that I set the fire unless you can produce an eye witness. Simply because you found my tracks at the fire does not prove that I set it." They know now that such proof can be made and that prosecution will be instituted whenever circumstances justify it.

Changed their minds, you say? Well, not exactly!

Experience has shown that in most cases the value of burning to the confirmed burner lies in his conception of the benefits he derives from a grazing, mining, or hunting standpoint. He is not interested in any explanation to the contrary, nor in the disastrous consequences that follow ill-advised burning. In all probability we will never be able to convert this type of burner. We can never take out of his heart and mind that desire to burn. However, experience has convinced us that we can counteract or neutralize that desire by convincing him that rigid prosecution is sure to follow any violation of the fire laws. That is prevention the hard way, but it seems to be the best way to successfully handle that type of individual

Region 5's record of approximately 35 felony cases successfully prosecuted in Federal Courts during the last two seasons is very encouraging, since circumstantial evidence is usually the only evidence obtainable. After all, circumstantial evidence, when properly prepared and presented, is often more convincing to a jury than direct evidence furnished by uncertain witnesses.

In practically every case there is some evidence on the ground at or near the origin of an incendiary fire. Someone has been there to set it, either by direct or indirect method, and has left some evidence of his presence. Our ability to detect and interpret that evidence enables us to make a start.

While it is generally conceded among forest officers that suppression of a fire is paramount to all else, the prevention angle should not be overlooked. If the cause is not determined and the perpetrator called to the bar, there will in all probability be other fires from the same cause. Therefore, the investigation is as important as the suppression. If the investigation is not started at once, evidence on the ground may be obliterated either by the suppression crew or by the fire itself. It is a common and effective practice in this Region to have one man on each suppression crew assigned to the task of searching for and preserving any evidence on the ground. He is the first man to hit the trail when the fire truck stops. He goes ahead of the crew to search for clues. If he finds tracks he covers them in order to protect them. If possible, and circumstances will permit, he may build a fire line around them to prevent their being burned over until such time as a plaster cast can be made of them. Materials for making casts are carried as part of the equipment of each suppression crew.

Tracks

Tracks are among the most important clues. If a fire is set or other offense committed by human agency, someone must have walked or ridden to the scene to do it. He may cover up his tracks in the immediate vicinity of the offense or they may be burned over or otherwise obliterated before the investigator arrives. If no tracks can be found at or near the origin, it is necessary to widen out in circular fashion until the tracks are picked up. If the tracks, when found, indicate that the suspect has ridden away in a car, plaster of paris casts should be made of the tire tracks for future identification. If travel by foot or horseback is apparent, casts should be made of the best tracks found nearest to the fire.

Extreme caution is used in following horse or man tracks out; and all loops, detours, or short cuts are closely traced, even though the identity of the person suspected is fairly certain. The urge to go direct to his home for the purpose of questioning him is firmly suppressed. The investigator can

then truthfully and conscientiously testify as to the route taken by the suspect. If the suspect, or his horse, is overtaken, even though the suspect may make an admission of his guilt and signify his willingness to plead guilty, the precaution should be taken to secure another cast of the track followed from the fire. In case of a man track, the shoes are seized for use in the event trial becomes necessary. Shoes can be legally seized by consent of the owner or by authority of a search warrant. Sometimes a little diplomacy on the part of the officer will eliminate the necessity of obtaining a search warrant.

Experience has shown that casts of tracks when properly connected up are the best circumstantial evidence we can obtain in a fire case. Testimony is always strengthened by something material to present to a jury—something they can look at and compare for themselves.

If the officer is not a trained tracker—few people are—it is best to secure the services of one or more experienced trackers whose experience, when related in court, will suffice to qualify them as experts in the eyes of the court. Caution is used in such a selection to avoid the possibility of employing a tracker whose efficiency might be impaired by personal acquaintance or friendship in the community which might cause him to intentionally lose the track once he becomes convinced it is leading toward the home of some friend.

Fingerprints

Few people are acquainted with the value of fingerprints as evidence. They are very valuable where they can be obtained, give absolute identification, and are easy to use. They are produced by the oily impression of the minute ridges on the surface of the skin, and are left even when the hands are clean, although very faint when the skin is dry or immediately after washing it with soap. Fingerprints may be found on anything a man handles which has a reasonably smooth surface, such as papers, cans, bottles, tools, guns, etc. They can be developed or made visible by applying a very fine powder, known as fingerprint powder, which, when brushed or sprinkled on lightly, will adhere to the ridges of the pattern of the print. The surplus powder is shaken off or blown away, leaving a fairly plain impression. It is then photographed for later comparison and identification.

The only evidence found at the point of origin of a disastrous incendiary fire in 1933 was a broken bottle. On one of the fragments was found a fairly distinct fingerprint, which was photographed and preserved for future reference. The bottle, being of a peculiar type commonly used in

laboratories, was traced and identified as having come from a certain high school laboratory. Check of the stock of phosphorus on hand at the close of the school term disclosed a small amount missing.

Further investigation developed the fact that two young men, who often assisted a relative with the janitor work at the school, had access to the laboratory unobserved by the janitor. It was also developed that these boys were ardent deer hunters and usually hunted in the vicinity where the fire occurred; that they were seen going in and coming out of the area on the morning of the day of the fire; and that they had often complained of the brush making it difficult to hunt. They denied any connection with the setting of the fire, and refused to give their fingerprints for comparison with the print found on the bottle. Later, however, the prints of one of the boys were obtained, which disclosed that his right thumb had made the print on the bottle. Examination revealed 16 points of comparison or similar characteristics. The boys stood trial and were convicted by a single fingerprint, supported by other material circumstantial evidence.

Signed Statements

Signed statements by suspects and witnesses have proved to be invaluable in the investigation of fire cases. Occasionally a suspect is found who will refuse to sign a statement, but in most cases proper approach on the part of the investigator will bring results.

If a suspect is approached in a friendly manner and told that he is under suspicion, he will usually offer an alibi for his whereabouts at the time the fire started. If he is encouraged to talk and the investigator listens long enough, injecting a pertinent or adroit question now and then to keep him on the track, he will usually end up with a fairly good explanation. It is then indicated to him that his story sounds good, and he is informed that you want to get it straight by starting to write it down, taking him back over the story step by step with an occasional "that's correct, isn't it?" to which he will usually assent, and be impressed with the gullibility of the investigator.

When the statement is completed, the subject is told: "Now I want to read this over to you to be sure it is correct; if anything appears that you object to, we will change it." His signature to the statement is in the mind of the investigator all the time.

When the statement has been read to the suspect, he will be asked: "Now you have told me the truth, haven't you?" to which he will usually say "yes." Then the following is added to the statement: "I have read the foregoing statement and declare it to be true." The written statement is

then handed to him and he is asked to identify it by his signature. He will sign it without hesitancy in the belief that he has put across the idea that he is truthful and that he has explained away any suspicions that might have existed. His story is now available for check by the investigator, and in all probability the major part of it may be disproved. However, it is his story; he has declared it to be the truth, and he will stick to it in the belief that he has put it over.

When the case comes to trial, the suspect probably will have forgotten much of the detail set forth in the statement, and as a consequence he becomes cautious and confused. This will have a tendency to impress the jury with the fact that he is evasive and untruthful. Yet he cannot successfully deny the statement, for the reason that his signature appears thereon.

Fire investigations in the forests, under conditions where seldom an eyewitness to a violation is obtainable, are among the most difficult of all types of criminal investigations. Successful handling, therefore, requires experience, tact, and perseverance on the part of the investigator. It is not enough that a man must have had police experience. He must, first of all, be a woodsman familiar with woods and range conditions to the extent he can detect and interpret evidence on the ground. He must know the rules of evidence in order that he may not spend valuable time in an effort to develop some line of evidence that would not be admissible after he obtained it. He must be familiar with, or at least have a working knowledge of, the technical sciences commonly used in investigational work of a criminal nature, *i. e.*, photography, ballistics, fingerprints, handwriting, chemical analysis, etc. It is not necessary that he be capable of personally using them to reach a conclusion, but he must have a fair conception of their possibilities and know how to avail himself of those possibilities during the course of the initial investigation.

Region 5 at the present time employs nine such men on a temporary basis. They are selected on the basis of prior experience in investigational work and special adaptability. They are placed on forests where special law enforcement problems exist. They work directly under the Forest Supervisor. They attend an annual instruction class under the direction of the senior fire prevention and the Regional law officer, at which meeting written answers are given to one hundred or more questions on things they should know in connection with proper handling of their work. The answers are then taken up, and the subject matter indicated by each question is discussed. After the discussion is ended, written answers are again given to the same questions. In this way it is possible to determine the

effectiveness of the training course and also to appraise a man's ability to think clearly and to act accordingly.

This year's meeting indicated an average improvement of 37 per cent as a result of the discussions and tests. These men are used whenever possible as instructors in law enforcement classes at the spring guard training schools.

It is likewise intended that they shall be of special assistance to rangers and members of the protection force in developing their knowledge of the handling of law enforcement work. It is thoroughly understood that the employment of these men on a forest does not in any way relieve the staff members of their responsibility in the proper handling of their law enforcement work. They are intended as an auxiliary to the regular forces to assist with difficult cases. They are primarily prevention officers, and must also be capable of effectively delivering short prevention talks to schools, service clubs, camp-fire groups, etc., and developing and applying prevention measures of various kinds as the need is recognized.

Aside from the exceptions noted, the technique used in fire investigation is much the same as in other lines of similar endeavor, but practice, perseverance, and versatility in application of such technique are essential to proper progress.

In dealing with the fire prevention situation where every variety of circumstance and condition is encountered, the value of each man's service is largely conditioned by the extent and character of his knowledge of people and conditions in locations where specific fire problems exist.

The experiences gained and the results obtained in law enforcement indicate that we are making definite headway in meeting incendiary conditions. However, there are many other kinds of man-caused fires, and we must not be lulled into any sense of security on the false belief that the job is completed. On the contrary, fire-prevention efforts must be maintained to reduce to a minimum all man-caused fires.

Fire prevention is a large and continuing job and most important. It is necessary to develop and perfect the methods and technique by which prevention is successfully attained, keeping always in mind that this problem will increase with development and use of the forests.

SOUTHERN FIRE-BREAK PLOW

Louisiana Division of Forestry

The Hester fire-line plow has been widely and effectively used by Southern forest protective organizations for fire-break construction. This disc-type plow is manufactured in 4 models, including a 2-disc maintenance plow, a 3-disc utility plow, and a 5-disc plow in 2 styles. All models are designed for pulling behind crawler type tractors, and have adjustable wheels which govern the depth of the cut and on which the plow may be transported from one location to another without plowing. The purchase price ranges from $350 to $500.

Fire-line plowing with 40 H.P. tractor and 3-disc Hester plow in southeastern Louisiana

When in operation, the plows cast soil beyond the shoulders on either side of the actual cut, thereby increasing the effective width of the line plowed. Shipping weights and width of cut are as follows:

Model	Number of discs	Drawbar pull	Shipping weight	Actual width of plow cut	Effective width of fire line
Standard	5	25 H.P.	2445 lbs.	5–6 ft.	8– 9 ft.
Wide cut	5	35 H.P.	2539 lbs.	6–7 ft.	10–11 ft.
Utility	3	20 H.P.	1115 lbs.	3 ft.	5– 6 ft.
Maintenance	2	20 H.P.	1219 lbs.	6 ft.	

When in use, it is customary for the tractor operator to also operate the plow, which is designed to require no special operator. Usually an extra man or two is necessary to clear obstacles from the path of the tractor.

LOOKOUT MAP MOUNTING

Alabama State Forest Service

The following directions apply specifically to the mounting of 30-inch circular tower maps on prestwood (Masonite) base developed by the Alabama State Forest Service. The same methods may be adapted for other types of mounting.

Follow the procedure in order of numbered steps for satisfactory results:

1. Place map prestwood base on level wood surface with smooth side up and "tack" securely with several straight pins along the circumference to prevent moving during following operations.

2. Wash the smooth surface of prestwood base clean and let dry.

3. Brush paste evenly so that there is a smooth, unbroken film over the entire surface of base. *Caution:* Mix paste powder with water to make a *thick filmy paste*. Be sure paste is smooth, contains no lumps, and is thin enough for easy brush application.

4. Dampen underside of map.

5. Place map in position on the map base. *Caution:* Map must be placed so that tower is in *exact* center of map base. Do this by first driving vertically a pin (without head) in the exact center of the $\frac{7}{16}$-inch hole of the map base. Of course, the pin must be driven into the surface on which the base rests. Then the map is placed in position, with the pin protruding through the map at the *exact* location of the tower.

6. Roll map smooth with roller, expelling excess paste from under map. Use a moist cloth to keep surface of map soft and pliable during rolling operation. *Caution:* It takes considerable time to complete this operation. Excess paste must be expelled gradually at the edge of map. The excess paste helps to improve the bond between map and base because it works up into the paper.

7. Apply damp cloth frequently to surface of map throughout the entire rolling operation. *Caution:* DO NOT LET MAP DRY. Otherwise map cannot be rolled smooth and free of wrinkles.

8. Remove with a clean wet cloth any paste which may have gotten on surface of map following the rolling operation. Let map dry.

10. After Azimuth circle and map are thoroughly dry remove pins and give "backside" (or rough side) of prestwood base a coat of shellac in a strip 3 inches wide along the outer edge. When shellac dries it provides surface for tape to adhere to.

11. Binding or taping operation provides for binding the edge of the Azimuth circle and map securely to the map base. Cut "Scotch Masking Tape" in pieces 3 inches long. Moisten a piece and place one *end* in position on the margin (¼ inch) provided on the Azimuth circle. Lap other end of tape over the edge of map base and press firmly in place on the under side. Repeat this operation with each succeeding piece of tape, overlapping a little until the entire edge of map is protected by tape.

12. Complete all detail to be shown on map, including water coloring of ownerships.

13. Apply two coats white shellac all over mounted map—top and bottom.

14. Apply two coats clear spar varnish all over top and bottom. *Note*—Spraying is more desirable than brushing on shellac and varnish. *Caution:* If using brush, be careful not to "bleed" colors and ink used in giving additional detail.

15. Mounted map is placed in oriented position on 30-inch circular tower map table and held in place by copper band completely encircling the map and tacked in place at 3-inch intervals. Tacks are driven through copper band into table top.

16. Each map is provided with a sack-like waterproof canvas cover large enough to cover table and telephones, and with grommets and drawstring.

17. Cover is kept in place at *all* times when tower is not manned.

Materials for Mounting Tower Map

1. *Base*—Material—Prestwood $\frac{3}{16}$ inch thick. Circular in shape, with $\frac{7}{16}$-inch hole in center for alidade socket bolt.

2. *Azimuth Circle*—Made of paper 30 inches in diameter and 1½ inches wide, including ¼-inch margin along outside circumference to permit taping.

9. Mount Azimuth circle in position, using the same procedure outlined for the map.

3. *Map*[1]—Circular, 30 inches in diameter, scale ½ inch to 1 mile. Tower located at center of map. Principal land ownerships water colored. Place legend on unused portion of map, if advisable. All other towers should be shown on map and provided with suitable azimuth circle. (5 inches to 7 inches diameter.)

4. *Paste*[2]—Ordinary paper hangers' paste, purchased in dry powder form at 15 or 20c per pound.

5. *Paint Brushes*—(a) Small, flat brush for applying paste; (b) Camel hair brushes for water coloring; (c) Small, flat brushes for applying shellac and varnish.

6. *Cloth*—Supply of cotton cloth. Include one or two pieces large enough to completely cover map.

7. *Roller*—Small hand roller (1 inch wide and 1⅜ inches in diameter), Ridgeley No. 12 or similar.

8. *Pins*—Supply of ordinary straight pins.

9. *Tape*—Roll "Scotch Masking Tape" ¾ inch wide.

10. *Shellac*—Quantity white, clear shellac.

11. *Varnish*—Quantity clear spar varnish.

12. *Spray Gun*—If available, spraying is best method to apply shellac and varnish.

This completes the mounting procedure.

Additional Equipment Used in Towers

13. *Map Table*—Circular, 30 inches in diameter—2 inches thick of wood, carefully sawed.

14. *Copper Band*—A copper band 30 inches in diameter, about 2½ inches wide, punched along center at 3-inch intervals for tacks, is used to hold map in place on table. Band slips over map and table and rests in place on map because of a round "bead." This bead also is a great protection for edge of map when in use in tower.

15. *Canvas Cover*—A large, round, flat-bottomed, waterproof, sack-like canvas cover, equipped with grommets and drawstring and large enough to cover entire map table and telephones.

[1]Texas uses black line prints because there is a minimum of distortion. Blue line prints last longer but distortion is too great.

[2]Arkansas prefers Frisket cement in order to minimize stretching or distortion. Texas prefers Sanford's Flo-Gum Paste (a water paste).

PRESSURE TABLES FOR RUBBER-LINED HOSE

By Fred W. Funke

Fire Equipment Specialist, Region 5

There has been a definite need for a simple method of determining what losses can be expected in 1-inch and 1½-inch rubber-lined hose. Curves and tables which have been available in the past are of little use to the field operator. His concern is with a specific problem, and he does not have curves to determine what is taking place on a given pumping job.

The following tables have been prepared to provide something which will answer the questions raised in pumping problems. The data are based on curves prepared by Roy Bainer, Assistant Professor of Agricultural Engineering of the College of Agriculture, University of California, at Davis, California. The curves were developed during an experiment with small size fire hose in 1930.

With the curves as a base, various weighing factors have been applied so that the data, while having been developed by interpolation of a series of control points, represent a calculation of sufficient accuracy for all practical purposes. It was an interesting thing to check the accuracy of the data against actual performance. The tables were developed primarily for use with tank truck pumpers, where various losses become involved due to piping systems. They are equally applicable, however, to portable field units.

It is hardly practicable to effectively distribute more than 15 G.P.M. on a moving fire front, due to inability of the average crew to shift a loaded hose line. In the interest of water conservation where tank truck equipment is used it is necessary for the pump operator to know what pressure and gallonage is required at the nozzle under any given set of conditions. Knowing the factors, it becomes a simple matter to determine what the pump pressure should be to provide a given amount of water at a given pressure at the nozzle.

A separate table is provided for the nozzle tips in general use from one-eighth to one-half inch. The use of the tables may be illustrated as follows (one-eighth-inch nozzle chart): Left-hand bracket indicates on the first line that if 3.1 G.P.M. is desired at the nozzle at a pressure of 50 pounds per square inch through 500 feet of 1-inch hose the pump pressure needed is 53 pounds per square inch. This holds only for a level ground condition.

If the water is pumped to an elevation, assume 130 feet, there is indi-

cated in the lower block under "Pressure in Pounds Per Square Inch For Different Heads of Water," in the fifth column from the left under 30 and opposite 100, a factor of 56.3 pounds. This must be added to the loss of 53 pounds, giving a total of 109.3 pounds per square inch at the pump to deliver 3.1 gallons of water at 50 pounds pressure through 500 feet of 1-inch rubber-lined hose to an elevation of 130 feet.

Once the operator learns that the upper table represents friction loss in the hose and the lower table loss due to the height the water must be lifted, little trouble will be experienced.

It will be noted from the tables that intermediate points may be interpolated. Also, it is possible to determine in advance the limitations imposed by a particular pumping job. As an example: It can be determined from the ¼-inch nozzle chart that 22 G.P.M. could not be pumped through 3,000 feet of 1-inch hose and lifted 800 feet above the pump without developing a pressure of 1,041 pounds at the pump. Obviously such a task would be ruinous to the hose.

1/8 " NOZZLE

1. Select desired nozzle pressure or gallons per minute and find the corresponding pump pressure from the following table.

DESIRED Nozz Press	or GPM	PRESSURES AT PUMP FOR THE FOLLOWING HOSE LENGTHS — Length of 1" hose line 500	1000	1500	2000	2500	3000	Length of 1 1/2" hose line 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	or GPM
50	3.1	53	55	58	60	63	65	51	51	52	52	52	53	50	3.1
60	3.4	64	66	69	72	75	78	61	61	62	63	63	64	60	3.4
70	3.7	74	77	81	84	88	91	71	72	72	73	74	74	70	3.7
80	3.9	85	88	92	96	100	104	81	82	82	83	84	85	80	3.9
90	4.2	95	100	104	108	113	117	91	92	93	94	95	96	90	4.2
100	4.4	106	111	115	120	125	130	101	102	103	104	105	106	100	4.4
110	4.6	116	122	127	132	138	143	111	112	113	114	116	117	110	4.6
120	4.8	127	133	139	144	150	156	121	123	124	125	126	127	120	4.8

2. Add the estimated lift converted to pounds per square inch from the following table and you have the gauge pressure required at the pump. (Subtract when pump is above the nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head feet	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	305
900	390	394	398	403	407	411	416	420	424	429

3/16" NOZZLE

1. Select desired nozzle pressure or gallons per minute and find the corresponding pump pressure from the following table.

DESIRED Nozz Press	or GPM	PRESSURES AT PUMP FOR THE FOLLOWING HOSE LENGTHS — Length of 1" hose line 500	1000	1500	2000	2500	3000	Length of 1 1/2" hose line 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	or GPM
50	7.0	61	71	80	90	99	108	53	55	57	59	61	64	50	7.0
60	7.6	73	84	94	105	116	127	63	66	68	70	73	75	60	7.6
70	8.2	85	97	109	121	133	145	74	76	79	82	84	87	70	8.2
80	8.8	96	110	124	138	151	165	84	87	90	93	96	98	80	8.8
90	9.3	108	124	139	154	170	185	94	97	101	103	106	109	90	9.3
100	9.9	121	138	155	172	189	206	105	108	110	115	118	121	100	9.9
110	10.3	132	151	170	188	207	225	115	118	122	125	128	132	110	10.3
120	10.8	145	165	185	206	226	247	125	129	132	136	139	143	120	10.8
130	11.3	157	179	202	224	246	269	135	139	143	147	150	154	130	11.3
140	11.7	169	193	217	241	265	289	145	149	153	157	161	165	140	11.7
150	12.1	181	206	232	258	283	309	155	159	163	167	171	175	150	12.1
160	12.5	193	220	248	275	302	330	165	170	174	178	182	186	160	12.5
170	12.9	205	234	263	292	322	351	176	180	184	188	192	197	170	12.9
180	13.2	217	247	278	308	339	369	186	190	195	199	203	207	180	13.2

2. Add lift in pounds per square inch from the following table ard you have the gauge pressure required at the pump. (Subtract when pump is above nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head Ft.	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	385
900	390	394	398	403	407	411	416	420	424	429

1/4 " NOZZLE

1. Select the desired nozzle pressure or gallons per minute and find the corresponding pump pressures from the following table.

DESIRED Nozz Press	DESIRED or GPM	PRESSURES AT THE PUMP FOR THE FOLLOWING HOSE LENGTHS: Length of 1" hose line 500	1000	1500	2000	2500	3000	Length of 1 1/2" hose line 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	DESIRED or GPM
50	12.4	82	109	136	163	190	217	56	60	64	68	72	76	12.4	50
60	13.6	99	131	164	196	228	261	66	71	75	79	84	88	13.6	60
70	14.8	116	154	193	231	269	308	77	82	86	91	96	101	14.8	70
80	15.7	132	175	218	261	304	347	87	92	97	103	108	114	15.7	80
90	16.6	148	196	244	293	341	389	98	104	109	115	121	126	16.6	90
100	17.6	165	219	273	328	382	436	109	115	122	128	134	141	17.6	100
110	18.4	181	240	300	359	418	478	120	127	134	141	147	155	18.4	110
120	19.3	198	264	329	394	459	524	131	138	146	154	161	169	19.3	120
130	20.0	214	284	354	424	494	564	142	150	158	166	174	183	20.0	130
140	20.8	231	307	382	458	434	609	152	161	170	179	188	197	20.8	140
150	21.5	247	328	409	490	571	652	163	173	182	192	201	211	21.5	150
160	22.2	264	350	436	522	608	695	174	184	194	204	215	225	22.2	160
170	22.8	279	370	461	552	643	734	185	196	206	217	228	238	22.8	170
180	23.6	297	395	493	590	687	784	196	207	219	230	242	253	23.6	180

2 Add the estimated lift in feet converted to pounds per square inch from the following table and you have the gaugo pressure required at the pump. (Subtract when the pump is above the nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head feet	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	385
900	390	394	398	403	407	411	416	420	424	429

5/16" NOZZLE

1. Select the desired nozzle pressure or gallons per minute and find the corresponding pump pressure from the following table.

DESIRED Nozz Press	DESIRED or GPM	PRESSURES AT PUMP FOR THE FOLLOWING HOSE LENGTHS: Length of 1" hose line 500	1000	1500	2000	2500	3000	Length of 1 1/2" hose line 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	DESIRED or GPM
50	19.4	129	195	261	327	393	459	61	69	76	84	92	99	50	19.4
60	21.3	155	234	314	393	472	551	73	82	92	101	110	120	60	21.3
70	23.0	181	274	366	459	551	644	85	96	107	118	129	139	70	23.0
80	24.5	206	311	416	521	626	731	97	110	122	134	146	159	80	24.5
90	26.0	232	350	469	587	705	823	109	123	137	151	165	179	90	26.0
100	27.4	258	389	521	652	784	915	122	137	152	168	183	198	100	27.4
110	28.8	284	429	574	720	865		134	151	168	185	202	219	110	28.8
120	30.1	310	469	627	786	944		146	165	183	202	220	239	120	30.1
130	31.3	336	507	679	850			158	178	198	218	238	259	130	31.3
140	32.6	363	549	735	921			171	192	214	236	258	279	140	32.0
150	33.6	387	585	782	980			182	206	229	252	275	298	150	33.6
160	34.7	413	624	834				195	219	244	269	293	318	160	34.7
170	35.8	439	664	889				207	233	259	286	312	338	170	35.8
180	36.9	466	704	942				219	247	275	303	331	359	180	30.9

2. Add the estimated lift in feet converted to pounds per square inch from the following table and you have the gauge pressure required at the pump. (Subtract when the pump is above the nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head feet	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	385
900	390	394	398	403	407	411	416	420	424	429

3/8" NOZZLE

1. Select the desired nozzle pressure or gallons per minute and find the corresponding pump pressures from the following table.

DESIRED Nozz Press	or GPM	PRESSURES AT THE PUMP FOR THE FOLLOWING HOSE LENGTHS — Length of 1" Hose Line: 500	1000	1500	2000	2500	3000	Length of 1 1/2" hose line: 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	or GPM
50	27.9	213	350	486	622	758	895	72	88	104	120	136	152	50	27.9
60	30.6	257	421	584	748	912		87	106	125	144	164	183	60	30.6
70	33.1	300	492	684	875			101	124	146	169	191	214	70	33.1
80	35.3	342	560	778	996			116	141	167	192	218	244	80	35.3
90	37.5	385	631	878				130	159	188	217	246	275	90	37.5
100	39.5	428	701	974				145	177	209	241	273	305	100	39.5
110	41.4	470	770	1070				159	194	229	265	300	335	110	41.4
120	43.3	514	842					174	212	251	289	328	366	120	43.3
130	45.1	557	913					188	230	272	313	355	397	130	45.1
140	46.8	600	983					203	248	293	338	382	427	140	46.8
150	48.4	642	1052					217	265	313	361	409	457	150	48.4
160	50.0	685	1123					232	283	334	386	437	488	160	50.0
170	51.5	727	1191					246	300	355	409	464	518	170	51.5
180	53.0	770	1261					261	318	376	433	491	549	180	53.0
190	54.5	814	1334					275	336	397	458	519	580	190	54.5
200	55.9	856	1403					290	354	418	482	546	610	200	55.9
210	57.3	899						304	372	439	506	573	641	210	57.3
220	58.6	941						319	389	459	530	600	671	220	58.6
230	60.0	986						333	407	481	555	629	702	230	60.0

2. Add the estimated lift in feet converted to pounds per square inch from the following table and you have the gauge pressure required at the pump. (Subtract when the pump is above the nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head Feet	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	385
900	390	394	398	403	407	411	416	420	424	429

1/2 " NOZZLE

1. Select the desired nozzle pressure or gallons per minute and find the corresponding pump pressure from the following table.

DESIRED Nozz Press	or GPM	PRESSURES AT THE PUMP FOR THE FOLLOWING HOSE LENGTHS — Length of 1" hose line: 500	1000	1500	2000	2500	3000	Length of 1½" hose line: 500	1000	1500	2000	2500	3000	DESIRED Nozz Press	or GPM
50	49.6	567	997					121	121	131	136	141	146	50	49.6
60	54.3	679	1195					145	205	266	326	386	447	60	54.3
70	58.9	799	1406					170	241	312	383	454	525	70	58.9
80	62.8	908	1598					193	274	355	436	517	597	80	62.8
90	66.6	1021						217	308	399	490	581	672	90	66.6
100	70.2	1135						242	343	444	545	646	748	100	70.2
110	73.7							266	377	489	600	711	823	110	73.7
120	76.9							290	411	532	653	775	896	120	76.9
130	80.1							314	446	577	709	840	972	130	80.1
140	83.1							338	480	621	763	904	1046	140	83.1
150	86.0							362	514	666	817	969	1120	150	86.0
160	88.9							387	549	711	873	1035		160	88.9
170	91.6							411	583	755	927	1099		170	91.6
180	94.3							435	618	800	982	1164		180	94.3
190	96.8							459	651	843	1035			190	96.8
200	99.3							483	685	887	1089			200	99.3
210	101.8							507	720	932	1145			210	101.8
220	104.2							532	754	977	1199			220	104.2
230	106.6							557	790	1024				230	106.6
240	108.8							580	822	1065				240	108.8
250	111.1							604	857	1110				250	111.1

2. Add the estimated lift in feet converted to pounds per square inch from the following table and you have the gauge pressure required at the pump. (Subtract when the pump is above the nozzle.)

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

Head Feet	0	10	20	30	40	50	60	70	80	90
0	0	4.3	8.7	13.0	17.3	21.6	26.0	30.3	34.6	39.0
100	43.3	47.6	52.0	56.3	60.6	64.9	69.3	73.6	77.9	82.3
200	86.6	90.9	95.3	99.6	104	108	113	117	121	126
300	130	134	139	143	147	152	156	160	165	169
400	173	178	182	186	191	195	199	204	208	212
500	217	221	225	230	234	238	242	247	251	256
600	260	264	269	273	277	281	286	290	294	299
700	303	307	312	316	320	325	329	333	338	342
800	346	351	355	359	364	368	372	377	381	385
900	390	394	398	403	407	411	416	420	424	429

A GENERAL PLAN FOR THE USE OF RADIOS ON FIRES

By A. K. Crebbin

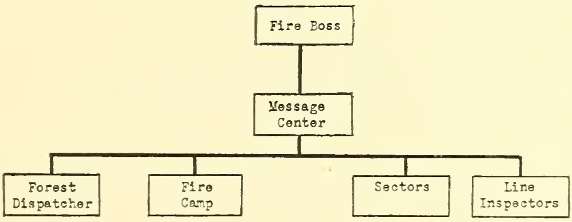
Technical Assistant, Klamath National Forest

The radio has been a great step in advancement of communication on fires. But the improved efficiency of the radio is not the end to improved communication. The radios on a fire will be only as valuable as the increased communication can synchronize and centralize the fire-control functions.

The object of this plan is to converge all radio communication to avoid confusion in lines of communication and to centralize all information and orders pertaining to the fire to further coordination in the suppression functions.

To do an effectual job of fire suppression the fire boss must have communication to the fire-line sectors, line inspectors, scouts, fire camp, and forest dispatcher. And as the fire boss must have mobility for the performance of his duties it is impossible for him to be in constant communication with these points. Therefore the point of convergence of radio communication is set up as a message center, which is the only point of contact authorized for all sets used in the suppression of the fire.

The following diagram shows the communication authority:

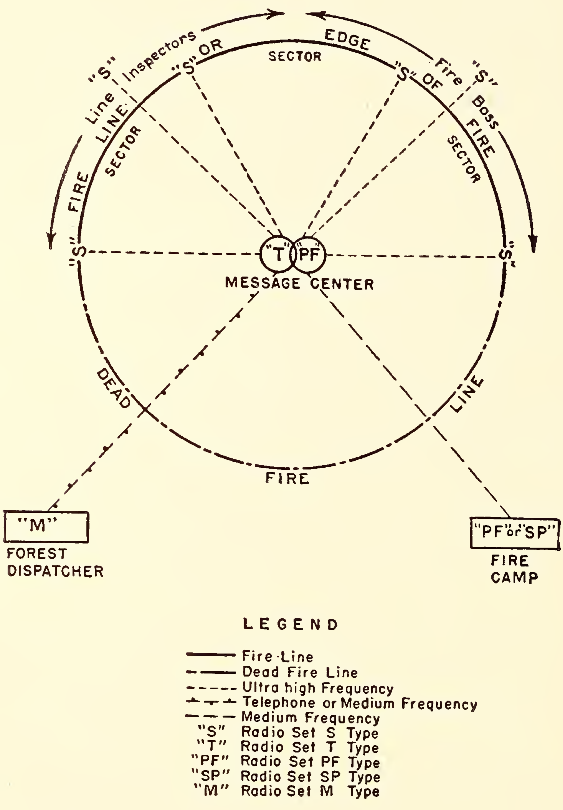


The message center is the nerve center of the fire-control activities. It receives all information on fire-control strategy, fire conditions, fire-control orders, and location and amount of manpower and supplies on the fire line, in the fire camp, and on call at headquarters.

This information is logged and, when necessary, relayed to the proper station. The information is also segregated on forms, maps, etc. (after the general practice on the unit where the fire occurs), to be readily available for the guidance of the fire boss and other officers.

The message-center chief is ex-officio fire boss, as he is the mouthpiece and information center for the fire boss.

FIRE RADIO COMMUNICATION PLAN



The illustration represents diagrammatically the lines of communication, frequencies, and sets used for communication between the message center and all of the fire-control stations.

Our communication frequencies are of two types—ultra high and high. The ultra high frequency can be used only between intervisible or nearly intervisible points, while the high frequency is not dependent on intervisibility. Therefore, to obtain maximum efficiency out of both frequencies the message center should be located on a point having the most direct visibility over the entire fire area. It can be located within the fire in a

"cold" area, on a point a considerable distance from the fire or in the fire camp. As the factors considered in locating the fire camp are nearness to fire, water, level ground, communication, and transportation, the fire-camp locations are not generally favorable locations for the message center.

The ultra high frequency is best adapted to the fire-line stations because the "S" sets are more readily portable, simple in operation, and points on all sectors of the fire line can generally be found to establish intervisible communication with the message center. And the high frequency is well adapted to message center—fire camp—dispatcher communication, as the dispatcher is generally equipped with a high-frequency set and the fire camp can be established in a favorable location without regard to intervisible communication with the message center.

It is also the duty of the message center chief to schedule all communication. The high frequency doesn't interfere with the ultra high frequency, and as the stations are few and widely separated a schedule isn't usually required. The following schedule is recommended for the fire line:

Starting on the hour, 3-minute schedule for a definite sector schedule, followed by 7 minutes for emergency calls and contact with fire boss, line inspectors, etc. This allows 6 cycles per hour, or 18 minutes for sector schedule and 42 minutes of open schedule.

The number of sets on the fire line should be governed by the same factors as is the size of a sector (size of job, importance of job, difficulties of travel).

It is recommended that one set with an operator be allotted to each sector.

The fire boss, line inspectors, and others may find it convenient either to contact the message center through the sector stations or to carry and operate individual sets.

The message center personnel should be large enough to operate both sets and to assist the message center chief to log and segregate all information. This system of communication enables the fire boss to supervise all of the fire-control activities and still be in direct contact with the latest developments. He can contact the message center from numerous places on the fire line with his "S" set, any fire-line station or the fire camp, and receive all of the fire information or relay orders to all fire-line stations, the fire camp and the forest dispatcher. He also informs the message center

of all fire-control strategy, which enables the message center to confirm all orders.

The key to success of this plan is the message center chief. He should be a man with the ability to segregate all the information and relay it without delay to the officers concerned, and also control the communication lines without confusion.

I have purposely avoided details, such as the servicing of radio sets, number of sets and batteries to be held in reserve, and where possible the personnel involved, as even within a Region forests have different methods of arriving at the same end.

On visualizing this plan please remember that it is a general plan, and that its principle is offered that it may be expanded or modified to fulfill the needs of fire suppression under various conditions.

OKLAHOMA FIRE LINE PLOW

OKLAHOMA FORESTRY DIVISION

The Oklahoma fire plow was originally developed by State Forester Glen Durrell, when Chief of Fire Protection in the Oklahoma Forest Service, and more recently improved by him while heading up the fire protection work in Arkansas. Both State organizations, therefore, may properly claim credit for the development and improvement of this power plow. Oklahoma is operating two of the plows successfully and Arkansas has one which is giving good results.

This tractor plow has the distinct advantage of portability and maneurverability, which is a most necessary requisite, as it is used for direct control on "going fires." One man operates the complete outfit, and it has the further advantage of being an attachment direct to the tractor. It is dispatched to a fire on a two-ton truck, loading and unloading under its own power.

The plow, middle buster type, is mounted on the end of a free swinging boom in front of a light crawler type, 20 H.P. tractor. The boom, coupled to the rear end of the tractor, extends forward under it and beyond the front end sufficiently to permit attaching the plow. Maneuverability is demonstrated by the fact that the tractor operator can lift the plow clear, which permits him to back up, travel, or avoid obstacles. He can also lower it into position for plowing. This operation is accomplished by means of a cable attaching the forward end of the boom to a lift drum operated by a worm reduction gear motivated by a hand-operated crank lever.

The plow has been operated very satisfactorily in fairly rough country such as is found in southeast Oklahoma and southern Arkansas. Obviously very steep terrain and areas where there is much down timber or bedrock would prevent satisfactory operation. In Oklahoma, the plow is used in shortleaf pine, oak and upland hardwoods types, where considerable loose shale rock is encountered, while in Arkansas it has been used principally in the loblolly-shortleaf pine type.

This plow attachment costs about $300, and must be constructed locally, since no standard specifications have been developed.

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and that no paragraphs be broken over to the next page.

The title of the article should be typed in capitals at top of first page, and immediately underneath it should appear the author's name, position and unit.

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually directly following the first reference to the illustration.

(OAKLAND-9-20-37-6,000)

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

No. 7

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

WHAT FUTURE HAS FIRE CONTROL NOTES?

Amazing results may be produced by cooperation. Accomplishments by the AAA and labor and business groups are determined primarily by the degree to which the principle of cooperation is applied. The world of science would be relatively barren without the highly developed cooperation which has grown up among scientists. Where the spirit of cooperation has been well developed, fire control has an effectiveness which does not otherwise exist. Cooperation or the lack of it will make or break FIRE CONTROL NOTES.

If workers in fire control take a pride in this publication as the organ of their occupational group, they will be critical of published articles having only a mediocre quality; if they feel an individual share in the collective responsibility for the character and quality of FIRE CONTROL NOTES they will be on the alert for chances to make, or get others to make, contributions which will be appreciated by readers concerned with the new science and art of fire control. When they find published articles of value to them individually, they will be impelled to respond by distilling from their own work the things which, if written up, would be of value to others.

The time has come when the publication will inevitably have tough going. The men most willing to contribute have done their share. The material most easily put in shape for publication has been printed. FIRE CONTROL NOTES will naturally feel the tendency to peter out. But it will take the upgrade promptly if workers in fire control really desire a publication devoted to that subject and cooperate to make it worthwhile. Will you individually do your share?

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THE FOREST SERVICE — U. S. DEPARTMENT OF AGRICULTURE

December 6, 1937

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FIRE CONTROL NOTES

DECEMBER 6, 1937

Forestry cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and technology may flow to and from every worker in the field of forest fire control.

CORRELATION OF REGIONAL FIRE DANGER RATING SYSTEMS

George M. Jemison

Associate Forester, Appalachian Forest Experiment Station, Asheville, N. C.

The pioneering of Gisborne and Shank has led to active interest in all Regions in the development of reliable devices for measuring and integrating the elements of fire danger. Without the aid of such devices a manager of fire control lacks command of facts which are essential to successful performance of his function. But much of the value of such devices will be lost unless they are so related to each other that fire danger can be correlated and compared for different types of country and different combinations of fire danger factors. In most Regions and for the country as a whole we now rate fire days as easy, normal, or bad. Human nature being what it is, our easy periods tend to be rated as normal, our normal ones as bad, and our really bad ones fail to be recognized as such. In a stimulating way the author discusses possible means of putting this sort of loose thinking behind us. With good response from other students of the subject our mastery of this problem should be speeded up.

The numerical system of rating fire danger[1] as originated by Gisborne in Region 1 has proved to be such a valuable aid to presuppression and suppression that all Forest Service Regions in the United States are committed to the development of danger rating schemes. Such schemes are useful in determining the number and distribution of men needed for effective fire control from day to day as fire danger fluctuates.

Not only is the daily rating of fire danger valuable, but administrators who wish to rate the relative efficiency of several fire control units or of any one unit for several years also find expressions of the severity of the entire fire season essential. Quality of fire control can be accurately rated only if statistics of number of fires, area burned, and cost are compared with ignitibility and combustibility of fuels as measured and expressed numerically.

[1]In this discussion, "fire danger" expresses the total of all temporary dangers that affect ignition and combustion; that is, abnormal occurrence, fuel condition, and weather.

Numerical danger ratings are definitely useful in fire prevention work, and great publicity value has been attached to them. In Region 1 the public is learning to think and talk classes of fire danger and, through newspaper reports during the past two fire seasons, has obtained a better understanding of danger. Furthermore, ratings of the severity of a fire season are essential considerations in determining the effectiveness of fire prevention campaigns. A reduction in number of man-caused fires may not be significant if accompanied by a decrease in ignitibility and combustibility.

Advantages of a national danger scale

Most of the advantages that apply to each of the regional danger rating systems also apply to a national danger scale and make the latter an essential for sound fire-control administration. Much can be gained by rating fire-control efficiency throughout the country, and certainly the publicity value of danger ratings can be capitalized upon nationally. While regular financing for fire control depends upon analysis of permanent dangers and normal conditions of fuel and weather, there will always be a need for distributing a varying amount of money from year to year, depending on the fluctuating temporary dangers in each region. The relative need for such funds can be determined only on the basis of a national danger rating scheme.

Limitations in the type of danger rating system

A single, universally applicable danger meter or similar device is out of the question because danger factors vary, or in some cases differ in relative importance from one place to another. For example, the occurrence of lightning storms constitutes a danger in the West, but does not in parts of the East where leafy hardwood stands are usually safe from fire during periods when lightning is frequent. In addition, inherent differences in the fire control problem among regions necessitate different steps in organization, hence require fire danger rating systems with different numbers of classes.

It is also impractical to construct danger meters for each region that rate danger in classes representing similar rates of spread. The great differences in rates of spread in fuel types existing in the several regions preclude the possibility of having class 5, for example, universally indicate the same spread in chains of perimeter increase per hour. This is indicated by a recent analysis of Region 7 fire reports[2] for the years 1930 to 1937, which shows that fires in even the slowest spreading fuel types in the

[2] Abell, C. A. Rate of spread and resistance to control data for Region 7 fuel types. September, 1937. Mimeographed report, Appalachian Forest Experiment Station, Ashcville, N. C.

region on an average day spread from 10 to 20 chains per hour faster than fires in the "extreme" rate-of-spread fuels in Region 1 on an average bad (class 5) day. Such differences make it impractical to aline Region 1 and Region 7 danger classes in regard to rate of spread. In statistical terms, the ordinary rates of spread of fires in the two regions represent different "populations."

Possible methods of expressing danger universally

A percentage expression of danger offers the best possibility of correlating various regional danger ratings and arriving at a national expression of severity of a particular fire season. Percentage ratings fill the requirements demanded of a national scale in that they are easily understandable by laymen and technical fire control men alike and express danger in exact and concrete terms, eliminating the possibility of personal differences in interpretation.

Percentage of numerical range: Perhaps the simplest method of determining the percentage danger rating for each region is by referring to the lower and upper limits of each numerical scale, equating them to zero and 100 per cent, respectively. In the southern Appalachians, for example, under this system class 5 will equal 100 per cent; in Regions 1, 6, and 9, class 7 will equal 100 per cent. In all cases mentioned class 1 represents zero per cent.

The bad feature of such a scheme is that never could this entire range from zero to 100 per cent be experienced. Actually, over a period of years, average seasonal danger would fluctuate between, say, 40 and 75 per cent. It would be difficult to visualize the relation between a 50 per cent rating and one of 60 per cent.

Percentage of normal danger: Expression of danger as a percentage deviation from a normal was first mentioned as a possible method of correlating regional danger ratings at the Mt. Shasta fire research meeting in 1936. In favor of normals is the fact that most people are accustomed to their use, and certainly plus or minus deviations would emphasize direction of departure from the average danger. It is difficult to interpret, however, how much worse a plus 20 per cent rating actually is than a plus 10 per cent deviation.

A disadvantage in the use of a normal as the basis for rating danger is that a unit of minus deviation may not span the same range of danger as a unit of positive deviation. As an illustration, suppose that in the southern part of Region 7 average danger is represented by class 2.8. On the scale of 1 to 5 that is being used, the greatest deviations possible would be.

theoretically, minus 64 per cent and plus 79 per cent. (Of course, actually they would be much less, because an average of class 1 or class 5 would never occur.) Only if the normal happened to coincide with the midpoint (class 3) of the range 1 to 5 would minus deviations be comparable to plus deviations.

In some cases it would be difficult to establish a normal danger class. Judgment cannot be relied upon to assist greatly in selecting the average where actual records are lacking because a season of normal danger rarely exists and is quite intangible to most men.

Percentage of "worst known" danger: At the Elkins meeting of fire control planners it was suggested that danger might be expressed as a percentage of "worst known danger." Theoretically, each region would find the worst year on record, compute the average danger class for that year, and thenceforth use this danger class as the 100 per cent point. No danger (class 1 on most scales) or "least known danger" could be used as the lower or zero per cent limit.

This scheme has the advantage of keeping severity ratings within the scope of probability. At least it would be possible to have years that rate from zero to 100 per cent. Therefore, the significance of the difference between two specific ratings would be much easier to visualize.

The average danger for the worst known year might not be a reliable base in some regions where danger meters have recently originated and are of such construction that past years cannot be rated unless actual fuel moisture measurements are available. In such cases ratings might need revision as years easier or worse than the "least and worst known" occurred.

Percentage of "worst probable" danger: One practical method of comparing units or years on the basis of a percentage danger rating has been demonstrated over a period of several years in Region 1. The method in use, developed and described by Gisborne,[3] converts the average danger class into per cent on a scale where 100 per cent equals a danger class called "worst probable danger" and zero per cent equals a class called "least probable danger." The limits which have been set up for July and August in Region 1 have been determined from records of the least and most hazardous seasons, augmented by the judgment of experienced men.

The Region 1 scheme, which really differs little from the "worst known" basis previously mentioned, could be expanded to operate on a national

[3] Gisborne, H. T. Measuring fire weather and forest inflammability. U. S. D. A. Circ. No. 398, 59 pp., 16 fig. July, 1936.

scale. In each region the limits of least and worst probable danger could be set upon the basis of actual past danger ratings plus experienced judgment. If the limits are correctly selected the per cents of worst probable, figured by every danger rating system, should be comparable. The regional per cents, weighted by the acreage that each represents, could then be combined into one figure expressing relative danger for the United States.

The feasibility of the whole plan depends upon whether or not the zero and 100 per cent points can be selected accurately. However, experience has indicated that this is not hard to do after a few years of fire danger measurements have been made. When field men become accustomed to rating danger on a numerical scale, their judgment is also a valuable aid in choosing the limits. Some of the danger meters recently developed in eastern regions are so constructed that they may be applied to old weather records, and ratings for past years can be obtained and used in determining the least and worst probable limits.

The Appalachian adaptation of "worst probable"

It might be possible to aline danger ratings following a scheme now being tried in the Appalachian Mountains and based upon Region 1's per cent of worst probable rating. Least probable and worst probable limits are at danger classes 2.0 and 4.0, respectively, for the Appalachian danger meter, which rates on a scale of 1 to 5. These limits, for the spring fire season, were selected on the basis of experienced judgment and actual ratings for past years. They bear the same relation to the total scale of 1 to 5 as the Region 1 limits (2.8 and 5.5 for July and August) do to the total scale of that danger meter, which is 1 to 7. Expressed as a proportion, 2.0:5 = 2.8:7 and 4.0:5 = 5.5:7. To illustrate the relation more clearly, the first expression would be read: danger class 2.0 is to class 5 (Appalachian meter) as 2.8 is to 7 (Region 1 meter).

It is not coincidence that caused the relative agreement of least and worst probable limits for the northern Rocky Mountain and Appalachian danger ratings. It seems entirely logical that the limits for any two systems should agree if the temporary dangers are properly integrated and if weather exhibits generally the same range of variation from the easy to the bad year.

Length of season

One important consideration necessary in rating danger and one not previously mentioned is the effect of length of season upon fire danger. If two regions have the same average fire danger, but in one the season lasts

eight months compared to four months in the other, obviously the relative danger is not equal.

A method of bringing length of season into the severity rating is mentioned as a possibility. From records and experienced judgment, the "longest probable season" might be determined. Severity ratings in per cent could then be adjusted on this basis. For example, if a season that rates 60 per cent of worst probable danger lasts for four months where the longest probable season is six months, $4/6 \times 60$ equals 40 per cent, the adjusted rating. A 100 per cent rating for a season would occur only if the worst probable danger lasted for the longest probable time.

The foregoing suggestion is offered with the realization that the writer may be accused of putting the cart before the horse in proposing a way to correlate something that cannot as yet be measured. At least to his knowledge no satisfactory way has been propounded for measuring length of fire season. However, when we know the way in which a variable may be used, the development of a satisfactory way of measuring it is often easier.

Perhaps length of season could be arrived at by tallying the total number of fire days that occur, a fire day being recognized as any day that demands some special organization for fire control. On most danger rating systems this would mean class 2 or worse. Then, the ratio between actual number of fire days and the greatest probable number would indicate length of season. This feature takes care of duration of season only; severity ratings take care of degree of danger in the season. Together they should give a very complete picture of the fire danger experienced on any protection unit.

Discussion

Of the various methods that have been described for rating severity of a season on a national scale, the writer favors the "worst probable" basis. The use of judgment and experience in selecting the limits needed is not desirable. This system or any other system should be carefully checked and adjusted as data for future years accumulate. However, the writer does not believe it necessary to wait several years to develop and test methods of correlating regional rating schemes. Much can be gained by trying out different systems now, using judgment where actual figures are lacking.

It is suggested that other regions and experiment stations now checking danger meters or similar devices set up least and worst probable limits for their scales. If these limits can be established in the definite ratio de-

scribed for the Appalachian Mountain region and still rate severity of a season logically, then a big step has been taken in bringing the ratings of various regions together.

Although past discussions have indicated that many workers feel the correlation of all danger rating scales will involve complicated mathematics, it is the writer's opinion that this part of the job will be relatively easy. The comparability of the several rating systems now in use is truly more surprising than their differences.

Recording Messages in Fire Camps—Keeping an accurate, usable, running record of messages sent and received in a large fire camp or at a message center on a fire is very neceessary. On going fires, it is often necessary to refer to messages which have previously been sent or received. Memory is unreliable and not transferable to the relief fire boss, camp boss, or other persons. In a fire camp of any size whatever this must take the form of a written record. A written record is also invaluable to a proper study of a fire at a Board of Fire Review.

Anyone who has compiled a message record for a large fire knows what a job it is if messages are kept currently in log books, on message blanks, or scraps of paper. On a fire in Region 5 in 1936, where as many as 1,300 men worked from a single camp, with two smaller camps usually operating at the same time, a regular "swing-arch" type of filing mount was used for recording messages. The filing mount was used on the customary letter-size board, but instead of being placed at the top of the board, it was attached in the middle. Regular radio message blanks and the memorandum (one-half letter size) pads were used. Holes were punched to fit the swing-arch and the pages were all torn off the pad before mounting. Carbon copies were made both of messages sent and received, and one copy given to the person concerned. The other copy was turned back to the top side of the arch and formed an orderly and chronological record of messages for use during a fire. For Boards of Review, significant messages were, of course, typed into a log form.—*C. R. Buell, Region 5.*

RATIOS OF PREVENTION COSTS TO OTHER COSTS

Fiscal Years 1934, 1935 and 1936

(R-10 omitted except in calculation of averages)

	EXPENDITURES ONLY					TOTAL FIRE CONTROL COSTS FOR PREVENTION, PRESUPPRESSION AND SUPPRESSION				
	Highest ratio prevention to presuppression		Lowest ratio prevention to presuppression		Average ratio (all Regions) prevention to presuppression	Highest ratio prevention to total Regional fire control costs		Lowest ratio prevention to total Regional fire control costs		Average ratio (all Regions) prevention to total costs
		Ratio		Ratio	Ratio		Ratio		Ratio	Ratio
FY 1934	R-5	81.07%	R-1	7.64%	34.24%	R-9	29 46%	R-4	5.74%	17.47%
FY 1935	R-2	129.58%	R-3	7.44%	35.48%	R-2	49.13%	R-3	4.89%	16.56%
FY 1936	R-2	48.93%	R-4	6 61%	22 81%	R-5	24.60%	P-3	3.72%	16.38%

SPECIAL POWER TAKE-OFF

F. W. Funke

Fire Equipment Specialist, Region 5

The standard power take-off furnished by motor car manufacturers was designed to carry heavy loads at low speed. It was intended to drive such units as hydraulic pumps for dump truck hoists, low-geared power winches, auxiliary transmissions, and various mechanical devices which require maximum torque at low speed of the driving shaft.

Probably the most important factor governing the design of the conventional power take-off is the size of the transmission gear with which the power take-off gear must mesh to receive its driving power. The size of this gear varies with the different transmissions used on the wide range of trucks available on the market.

The use of small water pumps with low horsepower requirement on tank trucks used in fire suppression work introduced a problem which could not be solved with existing equipment. Many of the small pumps required not more than 5 H.P. at maximum load. The ratios available in standard power take-offs required the engine to turn at one and one-half to two times greater speed than the take-off to secure a satisfactory pump speed on direct connected drive. This meant that the engine would be developing in many cases a speed equivalent to 30-40 H.P. to deliver a pump speed comparable to a load of not more than 5 H.P. Obviously, a drive ratio of this type is unsatisfactory from the economical as well as the mechanical viewpoint.

The cooperation of the Hercules Equipment and Rubber Company, of San Francisco, Calif., was enlisted in the development of a new type power take-off which would permit the maximum step-up in speed for a given transmission drive. Investigation revealed that such increase in driven gear speed is practicable in a few types of transmissions only. Fortunately, the Ford, Chevrolet and GMC T-16 truck transmissions, of which there are many in service in the field, are so designed that with suitable filler blocks a step-up power take-off can be mounted. The following ratios are available:

Ford and all Warner T-9 Transmissions

Engine Speed	Power Take-off Speed
800 RPM	1130 RPM
900 RPM	1275 RPM
1000 RPM	1415 RPM

Chevrolet and GMC T-16 Trucks

Engine Speed	Power Take-off Speed
800 RPM	945 RPM
900 RPM	1050 RPM
1000 RPM	1170 RPM

The design is straight forward mechanical construction of the heavy duty type with ball bearing mountings. A conservative rating of 15 H.P. has been assigned to the take-off, and it should serve any transmission drive application. The power take-off is of much more heavy construction than the transmission case, and the latter really is the limiting factor in power applications rather than the take-off.

The standard power take-off is rated for intermittent service at 8-10 H.P., but heavy duty designs, which are constructed with roller or ball bearings, have been in service delivering 15-20 H.P. on tank truck pumps for many years. There is no data available to indicate the maximum load which may be driven by a power take-off mounted in the side of a transmission. To the best of our knowledge no failures have resulted in transmission drives requiring as high as 18 H.P. Such heavy loads are not recommended for continuous service, but may be delivered for intermittent periods without undue heating of the transmission.

A power take-off of this type used in connection with a standard drive tube and two oil-tight universal joints, as used on automobile drive shafts, will make an ideal pump drive unit. The drive shaft or tube should, of course, be of the slip joint variety.

Region 5 can furnish information as to availability of this equipment.

Hopes for Hovering Payload—Accompanied by photographic illustrations of fantastic mechanism, there appeared in a recent issue of Popular Science Monthly a brief article describing a giant helicopter. All air-minded fire control men have dreamed of a hovering type of aircraft which will carry real weight. The autogiro of today cannot do it, so let us hope the answer is in the offing. The article is quoted herewith.

Plans for a giant transatlantic helicopter, capable of flying twelve passengers from New York to Paris in less than ten hours, have just been announced by a French airplane factory. A pair of three-bladed "windmills" of eighty-foot diameter, whirling in opposite directions above the airplane-type fuselage, are to lift and propel the proposed craft. Rotated by four motors totaling 3,600 horsepower, they will give the vertical-rising amphibian a forward speed of more than 300 miles an hour. A preliminary model of 300 horsepower, but with two-bladed instead of three-bladed "windmills," has already been built to test details of the projected machine, which is declared to have been made practical by recent advancs in helicopter design.

—Division of Fire Control, Washington.

NOTES ON NEW RADIO EQUIPMENT

A. G. SIMSON

Radio Engineer, Forest Service Radio Laboratory

This article furnishes the latest information on two new types of radiophones developed at the Forest Service Radio Laboratory and now supplied by that unit.

Ultra-high frequency Type SV

Work on a revision of the type S, which is designated as type SV, radiophone has been completed except for the method of packing. It has greater transmitting power than, and numerous refinements over, the type S. The front panel of this unit is 6 by 10 inches and the depth 5 inches. The weight will be about 16 pounds, complete with all accessories but without external speaker, which is optional. Although the transmitting and receiving circuits are electrically independent, provision has been made for "simplex" operation only, as in the type S.

The transmitter power output of the unit is approximately 1 watt, as compared to 1/10 watt for the type S. The circuit employed is similar to that of the type S, with the addition of an electrical filter for improving quality of voice reception. Ballast tubes have been used in the type SV instead of the fixed resistors used in the type S. These ballast tubes eliminate the necessity of filament rheostats and automatically compensate for the gradual reduction in A battery voltage as the batteries wear out, thus materially increasing the service life of the A batteries.

An additional audio stage has been included to increase the volume to that necessary to operate a small loud speaker. The speaker is not incorporated directly in the unit, but provision has been made for plugging it in externally, thus allowing the SV to operate standby and in many instances serve as a direct substitute for the type T radiophone. Although the loud speaker will only be supplied on special request, headphones will always be included with the set.

All batteries will be attached to the set by means of a plug and socket arrangement, thus allowing the light-weight portable batteries to be removed and heavy duty batteries plugged in for permanent or semi-permanent installations. In order to increase the transmitting power it has been necessary to increase the "B" battery voltage on the SV to 135 volts.

The estimated cost of the SV, with portable batteries and without speaker, is $70. The speaker unit will be about $5 extra.

High frequency Type I

Following is the latest data on the type I radiophone, which was de-

scribed briefly in the last Radio Equipment Bulletin.

The type I radiophone is a complete transmitter-receiver intermediate in power between the SPF and the M radiophone. It can only be operated from 6-volt storage batteries—not dry batteries—or 110-volt alternating current. The entire unit is mounted in a steel cabinet identical in size and shape to that of the 1937 model C, type M radiophone. In fact, the type I radiophone is primarily a modified M set for storage battery operation.

The receiver of the type I is a highly sensitive superheterodyne operating from the same storage battery source as is used to supply the transmitter. A vibrator type power supply similar to that in automobile radio receivers is employed in this receiver, thus eliminating the necessty for operating the transmitter dynamotor while receiving. The receiver does not use plug-in coils or band switching, and covers only the regular range of Forest Service frequencies, namely, 2900 to 3500 kc. A loud speaker is mounted in the front panel of the unit for standby service. A storage compartment for all accessories, such as dynamotor, antenna, halyards, phones, microphone, and telegraph key, is located in the rear of the cabinet.

The power rating of the transmitter is approximately 8 watts, as compared to 2 watts for the type SPF and 20 watts for the type M, and should provide a consistent working range of 25 or 30 miles and transmission up to distances of 200 miles or more under favorable conditions.

Current drawn from the storage battery is approximately 3 amperes for the receiver and 20 amperes for the transmitter. The transmitter employs the "push-to-talk" system, the same as that in the type M. The 20-ampere current is drawn only during the time the microphone button is depressed for actual voice transmission. The power output of the type I may be increased at any time to a maximum value of 20 watts by the substitution of a dynamotor of higher voltage and current rating. Such an increase in dynamotor rating will, of course, result in an increased drain from the storage battery of approximately 30 amperes. Thirty amperes is a very heavy battery load, and is not recommended except in unusual instances.

When installed in remote locations, storage batteries for the type I radiophone may be kept charged by means of any one of several commercially available gasoline-driven charging plants. Such plants weigh from 40 to 50 pounds and consume approximately ½ pint gasoline per hour.

In addition to its use at permanent and semi-permanent locations, the type I should fill an existing need for communication from fire trucks and other large vehicles. The estimated cost of the complete unit is $295.

ONE-WAY VERSUS TWO-WAY RADIO COMMUNICATION

W. M. Oettmeier

Forest Manager, Superior Pine Products Company, Fargo, Georgia

The progressive organization of which the author is Forest Manager initiated the use of radio in fire control on private land. He knows that the one-way system operates with complete satisfaction on the forest lands under his supervision. Having read the editorial "leader" at the head of the article by H. J. Malsberger in the August 9 issue, he was prompted to make this apt presentation of the respective merits of the two systems. Incidentally, it is an able argument for applicability of the one-way system to conditions in many sections.

When considering the installation of radio as a means of communication in any fire protective organization the question of whether a one-way or two-way system shall be employed must be decided. Either type may be used to great advantage, but several controlling factors determine the decision.

Where the forest area is readily accessible by car or truck, and where a system of telephone lines can be constructed, one-way communication is sufficient, and the use of a two-way system can be a handicap as well as an unnecessary expense. Two-way communication becomes a necessity in mountainous regions, such as the Northwest, where quite frequently a smoke chaser must first locate a fire as to topographical position in order to direct fire-fighting crews over the shortest and best route. Also, in such areas, where fires often reach extremely large proportions and there is an absence of telephone lines, two-way radio is necessary to establish communication with base camps and headquarters.

The principal disadvantages in two-way communication manifest themselves in many ways. The transmitter in the field cannot very well be used in a mobile position unless the ultra-high frequencies are used, and these frequencies are good for only a very limited range. Considerable valuable time is lost in stretching out an antenna and getting into communication, and more time is lost in taking down the equipment and packing it up. Portable transmitting equipment must necessarily be of low power, yet it is quite expensive.

In order to operate a transmitter in any private service the operator must be licensed by the government, and to obtain such a license he must know enough about radio to pass an examination. In any two-way service the transmitters in the field should be tested at frequent intervals to see that they are working satisfactorily, which in itself takes up a considerable part of the time of men who probably should be doing other work.

One-way radio can and is being used with a high degree of efficiency on

areas where a large portion of the territory can be covered by car or truck. In such cases receivers tuned to the transmitting frequency are mounted directly in the vehicle. Test calls are made by the fire dispatcher at frequent intervals merely to assure the man at the receiving end that everything is coming through and that his receiver is working.

When a fire call is sent out from the dispatcher to any crew working in the forest or to a ranger, the crew called can leave immediately and receive instructions while traveling. Ten to 15 minutes can be saved (an important factor on any fire) through this method, where it is unnecessary to first make several calls to get in communication, then take down and pack up portable equipment. Where radio is used it should never be considered as replacing the telephone, but should be used merely as a supplement thereto. In fact, the more telephone lines the greater the efficiency of the radio, especially when one-way communication is used. Crews carrying a small portable telephone, when summoned to a fire can call in from the first telephone line passed.

In using a one-way radio system several important factors must be kept in mind. The fire dispatcher must know at all times the approximate location of all rangers and crews equipped with radio receivers available for fire fighting. He must know that the receivers will be kept turned on during the hours specified and that the men will respond immediately to a fire call. Further, each person in charge of a radio-equipped car should report in by telephone if anything goes wrong with the receiver, even if this phone call necessitates a trip of 10 miles or more.

Receiver troubles are quite rare if the equipment is inspected once a month. If a test call is sent out every 30 minutes, a faulty receiver can easily be detected. After a few days' experience with such a receiver, however, one can tell almost immediately if something goes wrong with it, for when the receiver is working there is always a rushing sound from the speaker, and as long as this sound is heard one can be well assured that everything is operating satisfactorily.

In conclusion, it may be well to state again that both two-way and one-way radio communication have a place in fire protection. The two-way system, while probably a little more cumbersome and bulky, can be of more value in inaccessible regions. By some it may be thought that one-way communication is inefficient. On the contrary, where it can be used at all it is probably more efficient than the two-way system. A good example is the one-way system which has been in operation on the Suwannee Forest for approximately 4 years without a single failure. Fire losses during this period have been cut down to a very small fraction of 1 per cent, as against an average of 5 per cent before its installation.

A NEW FLOATING DISK COMPASS

H. M. White

Fire Control, Region 6

For years instructors at guard training camps had difficulty in teaching new men, and some of the old ones, how to use a quadrant compass. There were so many chances for error in reading this compass that fire executives were always afraid smoke chasers would go wrong when sent to fires where compass work was necessary. Then it occurred to somebody that the smoke chasers' compass should be graduated in azimuths, and for several years, in Region 6 at least, no quadrant compasses have been used by guards.

Changing to the azimuth graduation eliminated errors due to reading in the wrong quadrant when the needle settled near one of the cardinal points, and particularly when it settled between zero and the line of sight. The men still become confused, however, by the reversed position of the East and West markings, and there is a tendency to read the South end of the needle. The dial on the latest model carries a notation that the weight is on the south end of the needle, but the guard has to remember his instructions always to read the north end, and when running in a southerly direction he is apt to forget.

Last spring, Training Supervisor R. C. Lindberg suggested substituting for the compass needle a graduated aluminum disk with magnetized bar underneath, and he worked with a local instrument maker in designing a model. This compass has been shown to officers on a number of forests and has met with universal approval.

Just recently one of the standard smoke chasers' compasses has been changed to the disk type. Necessary changes were: removing the graduated ring and milling the inside of the case to give clearance for the disk, lengthening the pivot pin and substituting a jewel-mounted graduated disk and magnetized bar for the needle, putting in a new stop lever, producing the sighting line across the hinge and down to the glass, and inserting the ends of the metal ring holding the glass in holes drilled at either side of the line of sight so that this ring would not interfere with reading. It is estimated that compasses now on hand can be changed for $1.30 each in lots of 50.

The floating disk idea is not new, of course, but in other compasses of this type that we have seen the magnetized bar is riveted to the disk, so that the magnetic declination cannot be set off. In the Lindberg model the bar

is pivoted on the disk and held in the proper position by friction, making it easy to set off the variation accurately. So far as we know a floating disk is just as accurate as a needle and it settles more readily when the compass is held in the hands. The outstanding advantage of the disk, however, is that the correct reading is at the line of sight directly in front of the operator, no matter in what direction he is running, and the reading is not likely to be taken at any other point. Also, there can be no confusion as to the East and West markings, because the disk is graduated clockwise and these markings are not reversed.

It may be that readers of this description can point out disadvantages of this type of compass for smoke chasers. The only possible disadvantage we have thought of is the extra weight of the disk and bar, which might cause greater wear on the pivot pin and jewel. This should not be serious, however, if these parts are properly made.

Prevention Yardstick Questioned—The conclusions apparently drawn from the tabulation on pages 318 and 319 of the September number of FIRE CONTROL NOTES are seemingly very misleading. Of the 58 man-caused fires shown for the Cabinet National Forest, 25 are railroad fires. The number of visitors on the Cabinet Forest as reported does not include railroad travel, and since the Cabinet Forest is crossed by two transcontinental lines—the Northern Pacific and the Chicago, Milwaukee & St. Paul—it would seem that if the railroad fires are to be included the number of railroad visitors should also be included. The number of visitors is the number who visit the forest. The number of man-caused fires includes fires not only within the forest, but on lands outside of the forest where fires are handled by the Forest Service through cooperative agreement. An analysis of the 1937 fires, which is very comparable with the 1936 situation, shows that of 121 fires which the Cabinet Forest handled up to and including October 5, 1937, 59 were outside of the forest, and that of the 62 man-caused fires which the Cabinet Forest handled, 43 were outside of the forest. (There were only 5 man-caused fires on National Forest land.) If the conditions on the Cabinet are indicative of the conditions existing on other forests, would it not be well to revise the figures? Certainly, the tabulation does not give a correct picture of the conditions on the Cabinet.—*A. H. Abbott, Forest Supervisor, Cabinet National Forest.*

OREGON CONSTRUCTS A SPECIAL TANK TRUCK

J. W. Ferguson

State Forester, Oregon State Department of Forestry

Experience has demonstrated that there is a definite place in fire protection in Oregon for two types of tank trucks, a large unit constructed on a three-ton chassis and smaller units on the ton-and-a-half chassis.

The principal advantage of the larger truck is in the quantity of supplies and equipment that can be carried. In spite of the size and weight, it can be used on all roads in the State that are built on CCC standards. A single unit of this type was constructed for the Oregon State Department of Forestry this summer, and because of its design, completeness, and new and original features it is thought that a description might be of interest to other protection agencies which might have need of such equipment.

It is a specially designed tank truck constructed on a G. M. C. three-ton chassis with 160-inch wheelbase, dual transmission, giving ten speeds ahead and two reverse, hydraulic booster brakes and dual tires. Maximum width is 7 feet 6 inches. It is a metal panel job throughout, with all tools and equipment fully enclosed in compartments, yet easily and quickly accessible. Compactness and completeness were guiding principles in construction.

The water tank is of 525 gallons capacity, located immediately in the rear of the cab and resting directly on the truck frame in order to lower the center of gravity as much as possible. The power take-off pump is located on the right-hand side just to the rear and below the cab. The pump is of the Edwards gear type, constructed of metal that will withstand salt water.

Pumpers have been called into frequent use in the coastal area of Oregon, where it has been necessary to use the ocean as a source of water supply. A special clutch operated from the cab is provided for engaging the power take-off. The engine speed can then be controlled by a special throttle in the pump compartment. A system of valves makes it possible to pump either directly from a stream or from the tank.

The diameter of the intake is 2 inches. There are two 1½-inch outlets, one at the pump and the other at the right rear of the truck. With the use of Siamese connections, which are a part of the equipment, four streams of water can be thrown at a time. Capacity of the power take-off pump is 140 gallons per minute.

In addition, two Type Y portable Pacific Marine pumpers are carried, each weighing approximately 70 pounds and with a 70-gallon-per-minute capacity. These are in separate compartments on each side near the rear of the truck, mounted on pack boards and resting on sponge rubber cushions to prevent damage through vibration when the truck is moving. There are six 11-foot sections of suction hose—three of 2-inch diameter for the power take-off pump and three of 1½-inch diameter for the portable pumpers. Six tubes were installed in the body of the truck, each carrying a single section of the suction hose. These can be removed through a small 4-by-18-inch door at the left rear end of the truck.

The hose is carried in a special rack constructed on the top of the water tank. It consists of 1,600 feet of 1½-inch rubber-lined cotton hose, 500 feet of the same kind of hose but 1 inch in diameter, and 400 feet of 1½-inch linen hose packed in a sack and attached to a pack board. When the truck cannot be placed within suction hose reach of the water supply, one or both portable pumpers and hose can be carried to the stream and used in filling the tank or pumping direct to the fire. Two 75-gallon capacity relay tanks answer the problem where it is necessary to raise water to an elevation which either taxes the capacity of the pumpers or where back pressure might cause hose to rupture.

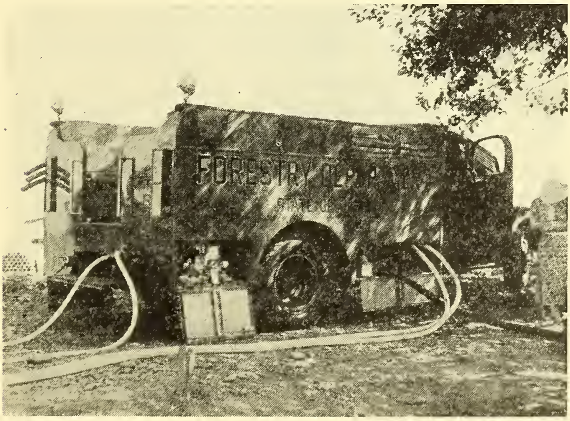
In a compartment in the rear of the truck, similar in construction to that which contains the suction hose but on the opposite side, are three 7-foot falling and two bucking saws, as well as hose connections and pumps for four back-pack pump cans.

There are two upholstered seats in the rear, facing each other, with sufficient room for 8 men. The backs and seat cushions are removable, giving access to the tool compartments. Carried in these are 12 shovels, 12 hazel hoes, 12 axes, falling and bucking wedges, sledges, two dozen electric flashlights for night fire fighting, extra batteries, first aid kit, saw handles, and extra pack boards and pack sacks. Beneath the bed at the rear is an auxiliary gas tank of 25-gallon capacity with gas already mixed with oil and ready for the pumpers, and a convenient valve for filling portable gas cans. Two additional portable gas cans are carried, also filled with gas, for the pumpers. These, together with four backpack pump cans, occupy a compartment on the left front side.

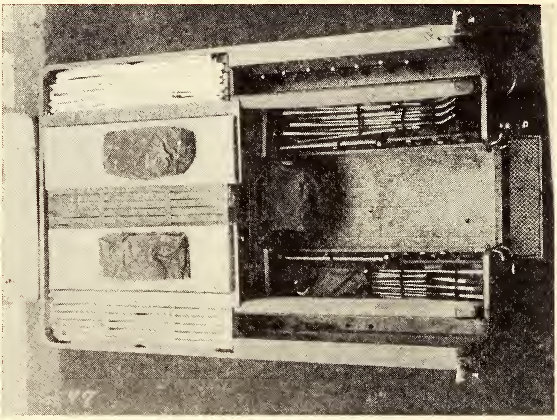
With the truck as now equipped it will provide hand tools and equipment for a crew of at least 50 men. However, in case of emergency it would be possible to carry at least double the number of hand tools in the truck bed between the two rear seats. A thousand-mile trip over various

roads throughout the State, together with severe tests of the pumping equipment, has demonstrated that the unit is extremely practical. It is powerful and speedy, and represents one of the most important additions yet made in the State's protective equipment.

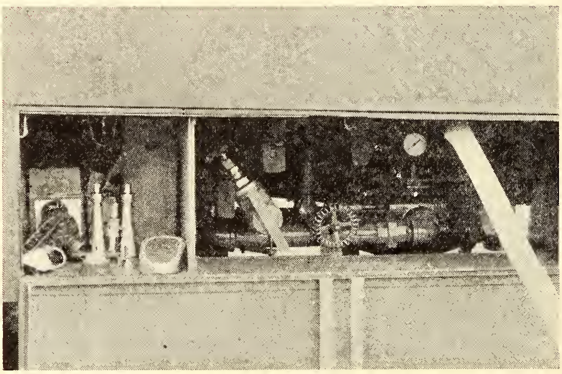
Tank truck recently placed in commission by Oregon State Department of Forestry



Side doors open, showing power take-off pump with hose connected, including suction and Siamese outlets at side and rear. Also Pacific Marine portable pumper in place. Small doors at rear for access to suction hose and saw compartments.



View from above, with seat cushions removed, showing tool compartments. Hose rack in front, with water tank underneath.



Close up of power take-off and pump

THE HANDLING OF THE BLACKWATER FIRE

David P. Godwin

Division of Fire Control, Washington

As soon as the news of the Blackwater Fire on the Shoshone National Forest was received in Washington, action was taken to investigate the circumstances of the tragedy. This article is a transcript of that portion of the investigative report of David P. Godwin dealing mainly with the organization and the attack.

1. *The Cause*—An electrical storm had occurred in the general vicinity of Blackwater Creek on Wednesday, August 18. The fire when seen from the air by Assistant Supervisor Krueger on August 20 appeared to be only about two acres in extent, and was in the creek bottom at a point indicated on the map.

A careful resurvey of the area on August 28 resulted in the discovery of the tree which had been struck. It was an alpine fir (Abies lasiocarpa) about 16 inches DBH, located on a low bench about 100 feet west of main Blackwater Creek. The tree was split to the ground and several large split slabs were scattered about the base. The ground litter at the base of the tree had evidently ignited at once. In the immediate vicinity the forest was fairly open, with little ground litter. The fire had evidently worked slowly uphill to the west and then with a change of the wind came down into the creek bottom, and later—on Friday—had started across the bottom and uphill in an easterly direction.

There was an unused trail (little more than a game trail) along the creek, but the first man to arrive found no indications of recent human use. There is no evidence whatever to indicate that the fire may have been man-caused.

2. *Reporting and Travel Time*—As shown in the chronological outline, the location of the fire was reported to District Ranger Fifield at the Wapiti Ranger Station at 3:45 p. m. Friday, August 20. At 3:52 p. m. he left for the fire, after having made his first call for the available men (20) then at the Wapiti CCC camp. En route he stopped at Blackwater Lodge, at the mouth of Blackwater Creek, and at 4:05 p. m. telephoned the Wapiti CCC camp for 50 more men (or all then available). He arrived at the fire at 5:10 p. m. This one hour and eighteen minutes is good travel time, considering the terrain, the stops made, and the fact that Fifield, being new in this district, was not thoroughly familiar with the territory. He had traveled 8 miles by highway, 3 miles by unused logging road, and 2 miles by unused trail.

The first crew (7 men and Foreman Bryan Sullivan of the Wapiti CCC

camp) arrived at the fire at 5:45 p. m. The second crew of 20 men from the Wapiti CCC camp arrived at 5:50 p. m. This latter crew had traveled 6 miles by highway, 3 miles by unused logging road, and 2 miles by unused trail.

By 8:00 p. m., Fifield had 58 enrollees and 7 overhead. The BPR camp, located about 3 miles up the highway from Blackwater Lodge, had been called upon at 10:30 p. m. to send a crew, but because none of the men were in camp it was not possible to get in touch with them until morning, and the crew of 9 men did not arrive at the fire until 10:00 a. m. Saturday, August 21.

The travel time on the whole was fair. With some crews it was very good. In the many later arrivals of CCC crews after Saturday noon the travel time was good. Consideration must be given to the fact that many of these movements were at night and over long distances, with need for stops. (See later discussion of travel time of the Tensleep crew.) The following is a statement of crews and their travel time:

Camp	No. Men	Time Called		Trav. Dist.	Time Arrived		
		Date	Hour		Date	Hour	
Wapiti	7	8/20	....	10	8/20	5:45 p.m.	(at fire)
Wapiti	22	8/20	4:05 p.m.	11	8/20	5:50 p.m.	"
Wapiti	15	8/20	4:05 p.m.	11	8/20	6:15 p.m.	"
Wapiti	7	8/20	4:05 p.m.	11	8/20	6:55 p.m.	"
Wapiti	7	8/20	4:05 p.m.	11	8/20	7:50 p.m.	"
Lake	54	8/20	8:00 p.m.	48	8/21	2:30 a.m.	At upper camp
BPR	9	8/20	10:30 p.m.	8	8/21	10:00 a.m.	" " "
Wapiti side camp	12	8/20	4:05 p.m.	76	8/21	10:00 a.m.	" " "
Tensleep	50	8/20	10:50 p.m.	182	8/21	12:15 p.m.	" " "
Deaver	50	8/21	1:30 a.m.	96	8/21	12:30 p.m.	" " "
Basin	51	8/21	9:00 a.m.	106	8/21	5:00 p.m.	" " "
Basin	33	8/21	....	106	8/21	11:00 p.m.	" " "
Worland	60	8/21	1:30 p.m.	137	8/22	1:00 a.m.	" " "
Thermopolis	64	8/21	3:45 p.m.	172	8/22	3:00 a.m.	" " "
Basin	20	8/21	3:45 p.m.	106	8/22	3:00 a.m.	" " "
Worland	24	8/21	3:45 p.m.	137	8/22	6:00 a.m.	" " "

Forest Supervisor Sieker's travel time, as with other unattached overhead, was especially good. He had left Sunlight Ranger Station at 4:30 p. m., had driven 43 miles to Cody and 48 miles from Cody to the lower fire camp, arriving there at about 8:30 p. m.

3. *Attack Plan and Man-Power Estimates*—Before seeing the fire Fifield had ordered all the men (20) he knew were in camp at Wapiti CCC camp. Sizing up the smoke from Blackwater Lodge, and knowing that more men were returning from work to the CCC camp, he phoned again and requested 50 additional men or all that were available. Upon his arrival at the fire and before the arrival of the men, he made what appears

to be a comprehensive reconnaissance. The first 7 men under Foreman Bryan Sullivan had come voluntarily, having seen the smoke from their work, and gone to work on the control line from the point later used as First-Aid Station, before finding Fifield.

When the first crew direct from Wapiti CCC camp arrived, Fifield put them on the control line around the bottom of the fire and up the east and west sides. He then sent a messenger back to Blackwater Lodge to phone for 50 more CCC enrollees.

Sieker, en route to the fire, being apprised of the situation and Fifield's orders for men, stopped at Blackwater Lodge at 8 p. m. and phoned the Park Service CCC Lake camp asking for 50 men (this is the exchange number of men previously agreed upon in cooperative arrangement between the Shoshone National Forest and Yellowstone National Park) to arrive at the fire at 3:30 a. m. Saturday, August 21. (They actually arrived at 2:15 a. m.) Sieker also ordered a pump outfit and an extra supply of beds from Denver (these arrived at the fire at 12:45 p. m. Saturday, August 21).

At 9 p. m. Friday night Sieker met Fifield on the fire line, and after conference and reconnaissance the two officers estimated that the fire, which was then fairly quiet, had covered an area of about 200 acres, and that by the end of the first work period they would have a perimeter of 450 chains. Eighty chains of control line had been constructed at the time of the estimate, and Sieker thought 370 chains could be constructed during the first work period by the 110 men on hand and on the way.

It was Sieker's and Fifield's judgment at that time (9 p. m.) that the fire would not spread appreciably during the night. Events proved they were in error in this calculation of probabilities. Neither Sieker nor Fifield made a written record of this judgment determination.

The area, though quiet, was smoky and difficult to scout. After midnight the wind sprang up, crowning appeared in several places, and the fire began to move out rapidly up the basin of the fork of the Blackwater Creek in a southeasterly direction. Sieker realized the situation had changed sharply, and promptly put in an order through Assistant Supervisor Krueger at Cody (1:30 a. m.) for 50 men from Deaver CCC camp and 50 local men from the town and vicinity of Cody. (The 50 men from Deaver and about 15 men from Cody arrived at the fire at noon Saturday.)

District Ranger Fifield was in charge of the fire. In accordance with the Region 2 fire plan the District Ranger automatically takes charge. Supervisor Sieker rightly respected that arrangement of authority, but because

of his greater experience and familiarity with local conditions worked with Fifield in an advisory capacity. Such practice as a general policy should result in the best development of ability and leadership in fire control. Sieker, of course, stood ready to relieve Fifield at any time he thought his management inadequate.

They had scouted the fire properly, had assembled all facts, had appraised the behavior of the fire, and had placed orders for the number of men they thought necessary to corral the fire in the first work period. It was their joint conclusion. It turned out to be wrong, because, in the experience of these men, a strong night wind under these given circumstances was not to be expected or to be included in probabilities.

After consideration of all circumstances, I conclude that Sieker and Fifield, from the factors available to them, took action properly and in sufficient time to insure corralling the fire in the first work period.

A second factor contributing to the subsequent disaster appears in a review of the events of Friday night. At 10:50 p. m., while the fire was still quiet, Sieker was able to get through a call to the Cody office (where the dispatching function was working smoothly) to have a crew of 50 men from Tensleep CCC camp (F-35 on the Bighorn National Forest) report in the morning. He estimated they could arrive at the fire (a distance of 180 miles) at 8 a. m. Saturday. (Because of delay in transmission of the phone call through the towns of Worland and Tensleep and to road stops the men did not reach the fire until about noon Saturday.) Sieker's estimate of travel time for this crew proved to be short by four hours, but he could not have anticipated that his order would be delayed two hours in transmission, and such a truck trip had never been made. It seems reasonable that the crew could have been expected to arrive at the fire by at least 10 a. m. This two hours' lost work had vital effects.

On Saturday morning, because of lack of strength (non-arrival of the Tensleep crew) new line construction on the forward end of the line (eastward from a point near what is now termed Clayton Gulch) had to be abandoned and all men deployed along the constructed control line from that point back to the crest of Trail Ridge and down Trail Ridge, in order to hold what they had and suppress small spot fires.

The plan was to have the Tensleep crew, with Ranger Post, leapfrog the Park crew, under Foreman Wolcott, and the BPR crew, under Foreman Bert Sullivan, and complete construction of the control line from near Clayton Gulch up to the rim rock under Double Mountain at the head of the ridge above Posts Point. If Post's crew had arrived at 10 a. m. they

would have had sufficient time to complete the line job well ahead of the 3:30 p. m. gale, which caused the blow-up.

It is purely hypothetical, but a logical speculation, that had this line been completed Post and Clayton and their overhead, freed from the drive of line building, would have had time to consolidate their position; burning out unburned spots southeast and above the line, improving the line itself, mopping up and watching for and treating spot fires far down to the northwest in the location which later developed the spot fire which did the great damage. In spite of such work that might have been done in that lost two hours, it is likely that the 3:30 p. m. wind would have crowned out some of the surface-burnt area above the line and caused abandonment, but routes of egress would have been simpler and well known, and the fatal spot fire below the line, having been discovered and treated, might never have blown up.

4. *Control Line Placement and Construction*—The first crew to arrive (detached crew of 7 men under Foreman Bryan Sullivan) started to work where they hit the fire, a point close to the later established First Aid Station (see map). With good judgment, Sullivan, who had not yet contacted Fifield, commenced line construction up the north flank of the fire, which was then the lee side. The 22-man Wapiti crew, which next arrived, was met by Fifield and put to work along the right flank (southwesterly side of fire). The three Wapiti crews next arriving (15, 7, and 7-man strength, respectively) were well distributed to both flanks, and by 8 p. m. 58 men and 7 overhead were building line in an orderly manner and with good speed.

The first pump arrived and was set up in Blackwater Creek and was operating by midnight. Hose lines from this and the pump received later from Denver were run about 2,000 feet up the north line and about 5,000 feet up the west line. This was most effective in controlling fire spread within the pump's reach.

The 54-man crew from NP-3 of Yellowstone Park arrived at the fire at 2:30 a. m. Saturday after the wind had whipped up the fire. Fifield, realizing that the north side was then the most dangerous, sent the Park crew through Foreman Hill's Wapiti crew, working on the north side, and on up the south slope of Trail Ridge. By daylight this crew had built and was holding line up to the open point on Trail Ridge above where the line later was cut down through the timber on the left of the ridge.

The long west side of the fire had been controlled by the line which had been built to timber line under the cliffs of Coxcomb Mountain. The hold-

ing of this control line saved the great body of dense timber covering the main upper basin of Blackwater Creek, which was threatened several times by shifts of wind.

Early Saturday morning the man-power was about evenly distributed to the two main flanks of the fire. Control line construction was good; well trenched to mineral soil and litter, logs and brush removed. In most instances the work was right along the fire. At the top of the line on Trail Ridge, however, where the fire was surface burning down over the ridge to the north, there were some islands unburned.

This control line under the north side of Trail Ridge and along the edge of the surface-burning fire was the tough position of the north sector and was being started Saturday morning by the Park crew when they were pulled off new construction to hold built line down along Trail Ridge. The first reinforcement in the morning was the BPR crew, with Foreman Bert Sullivan in charge, which arrived at the top of the line at about 11 a. m. They were placed ahead of the Park crew, and started in on this control line construction under the ridge. In character and in speed it appears to have been the best line built, yet it was the line which was lost.

Up until the time of the arrival of Ranger Post with his 50-man Tensleep crew, District Ranger Fifield had had charge of the whole fire. At 1:30 p. m., Supervisor Sieker, at Upper Camp, gave instructions to Ranger Clayton, who had just arrived, to take charge of the advanced sector extending east and north from Trail Ridge, leaving Fifield in charge of the rest of the line from there down to the bottom and all around the west and south sides. Ranger Post, who was to take the forward end of Clayton's sector, was sent up Trail Ridge with Foremen Saban and Tyrrell and the Tensleep crew, with instructions to relieve and send into camp the men of the Wapiti crew, under Foreman Hill, and to leave the Park crew of 25 men, under Foreman Wolcott, in place to hold their line. Post was to pass on beyond the BPR crew, who were then building line at the head, and carry forward the line north and east.

Sieker and Fifield had been on the job for almost 24 hours, so at 3:30 p. m., as previously planned, Sieker instructed Assistant Supervisor Krueger (who had just arrived) to take charge of all line from the west end of Clayton's sector, down Trail Ridge and all around the bottom and up the west and south sides, thus relieving Fifield. However, the blow-up came at this time, and Fifield and Sieker remained in charge of the whole fire. Before these two men eventually left the job they had been up about 64 hours.

Ranger Post had arrived at the Lower Camp at 9 a. m. Saturday, it being understood that he would take charge of the Tensleep crew, which at that time was on the road and expected to arrive about noon. In his talk with Krueger in Cody early in the morning it had been agreed between them that it would be better for him to await the crew at Lower Camp rather than go ahead alone up to the head of the line.

The control lines, on the whole, were located to the best advantage and were well cleared and trenched. Viewed in aftermath, it might be considered that the one exception to uniformly wise line placement was the fatal subsector extending east and north from the high point on Trail Ridge.

During Friday night and early Saturday morning the main fire slopped over through the saddle in the ridge above the highest point on the ridge line. The fire slowly surface-burned down the north slope of the ridge in dense timber. This situation prompted the decision to put through a control line under the fire and along the burning edge. The first work on this line was done by the Park crew.

About 11 a. m. the BPR crew, Foreman Bert Sullivan in charge, passed through the Park crew and proceeded to continue this line, building to the east. The fire made a short run down a side ridge, but the BPR crew swung the line down under it and had it extended about to the sharp ravine in which Clayton and 6 men were later trapped, when Post's crew came through them. In view of the possibility of spots developing below (which they did), and the approach of mid-afternoon, with its to-be-expected winds, the pushing through of a line on this slope by the Tensleep and BPR crews appeared in first judgment to have been a dangerous undertaking. It was, however, the obvious tactics to be pursued by men directing fire fighting to hold the area and save timber. These officers and foremen are trained in the principle of "the fire must be corralled." They did not consider the situation dangerous, and certainly did not consider the move rash. It was the logical way to stop the fire and save the whole basin to the north of Trail Ridge. They did not know there was a sleeping spot "down in the hole," nor did they know the relative humidity registered the extreme low of 6 per cent at the Wapiti Camp at 1 p. m.

Had they known these things, and anticipated an afternoon wind, their action probably would have been different. But, weighing the known factors, Post and Clayton thought the job a normal undertaking and one not involving more than ordinary risk to men. An alternate to this would have meant abandonment of this sector, pulling all men out to Trail Ridge. If they had done this, the only logical next step would have been to

move the crews, with a loss of several hours, up Trail Ridge, around the base of the cliffs of Double Mountain and down Posts Ridge (later named) or the ridge southwest of Logging Gulch and establish new lines. With the later crowning and running of the fire, these positions may have proved just as hazardous as the position they did occupy. With the knowledge they had, and in view of their fire-fighting experience, I feel that their judgment and decision were right.

5. *Circumstances of the Blow-Up and the Tragedy*—The statement of A. A. Brown, presenting an analysis and reconstructed picture of the behavior of the blow-up fire of Saturday afternoon and the tragedy in its path, follows this article. The subject, during the review, was presented by Brown and came under full discussion of the investigating group. The Forest and Regional officers and I agree with the analysis and concur in the conclusion set forth in this written statement.

A point not mentioned by Brown is that Assistant Supervisor Krueger, who was directly over the fire area at approximately 12:40 p. m. Saturday, saw two stringers of smoke from spot fires below the newly constructed line (running east and north from Trail Ridge). These, however Krueger reports, were close to the line, and have since been identified as spot fires being worked on and not the spot fire down "in the hole," which at about 3:30 p. m. blew up and became the greatest factor contributing to the disaster. That critical spot fire was evidently not throwing smoke at 12:40, for it was not observed by Krueger.

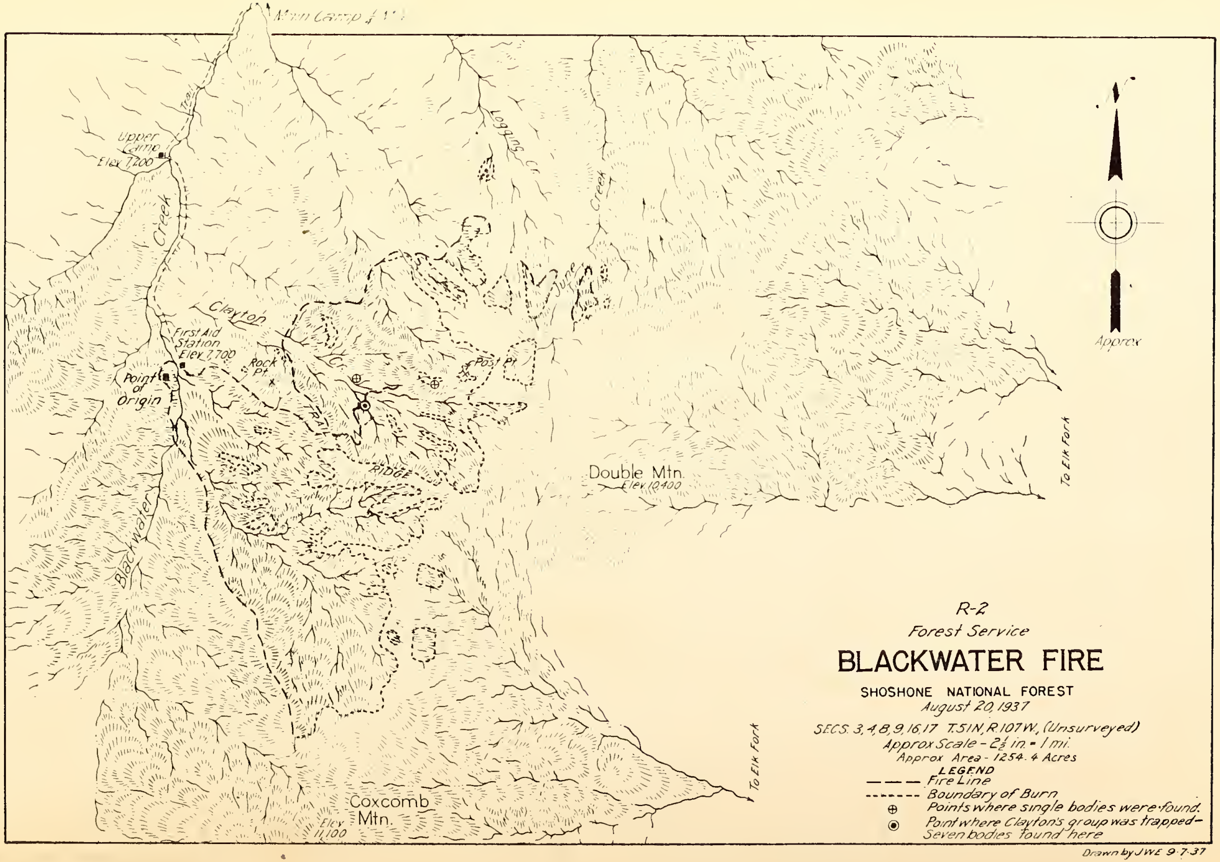
6. *Summary*—After careful review of all the circumstances and acts I find no reason for criticism or organizational change. In reaching this conclusion, full weight and consideration were given to certain things which might have been done differently and better: the communication system was not of the best; the local cooperators failed to turn out as per fire plan; the probability of a night wind Friday night was not a part of the calculation; failure of the Tensleep crew to arrive earlier on Saturday probably contributed to the disaster; there was a lack of written messages and time notations; some unburned fuel was left above the line.

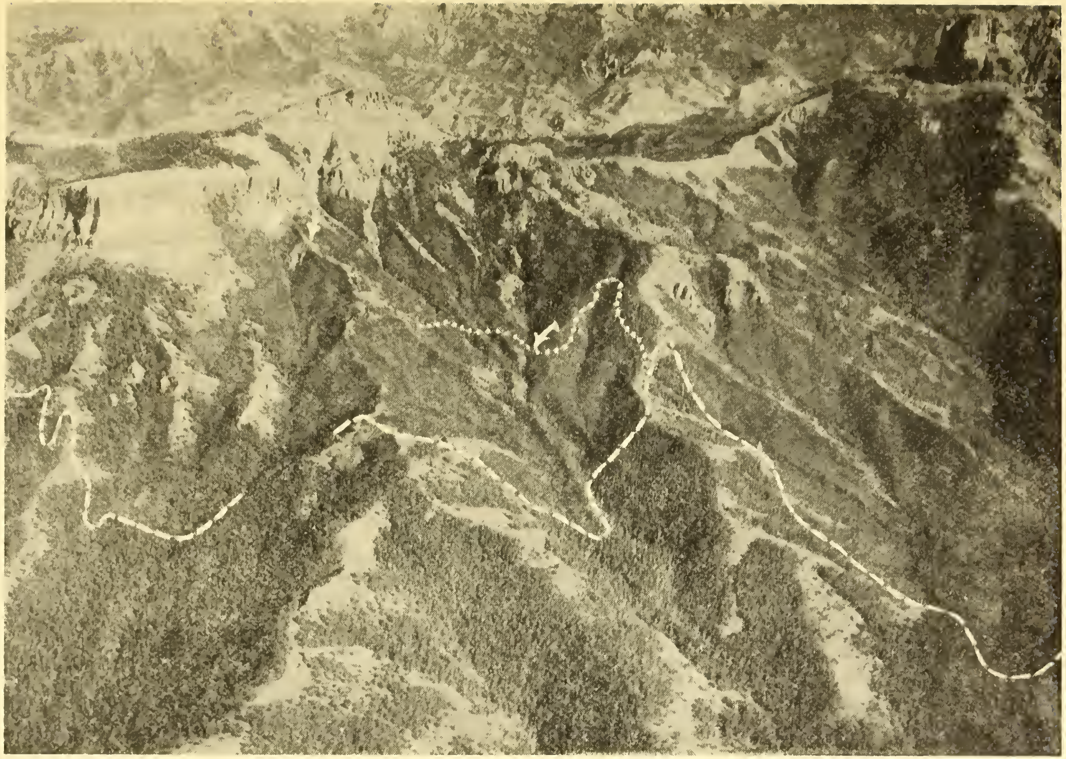
On the other hand, it is clearly evident that this fire was handled in a manner reflecting sound experience and knowledge. The placement and construction of control lines was well done, in spite of rough terrain and bad fuel. The large body of timber on the main basin of Blackwater Creek was saved by the handling of the west line. The camp management and feeding was efficient. Tools and equipment were sufficient and in proper condition. The enrollees were at all times under capable and watchful supervision

(overhead was in proportion of 1 to 10). The dispatching job and the assembly of suppression forces were adequate and well handled. The supervising personnel worked smoothly and without misunderstanding. They followed the approved Forest Service practices of fire control. Continuous hard work and intelligent action and courage show up through the entire four-day period.

Nothing can compensate for the distressing loss of human life, although there is some comfort in the knowledge that the leadership was intelligent and protective of the men.

Regrettable as it is, it must be recognized that in man's control of forest fires some accidents will occur—just as in city fire protection—without fault or failure on the part of anyone. Here was brought about a peculiar combination of circumstances rare in forest-fire history. It is reassuring to know that such occurrences are infrequent. Not since 1910 have so many lives been lost on a single national forest fire, and fatalities from burning are very uncommon, although probably more than 100,000 men fight fires in the average year.


R-2
Forest Service
BLACKWATER FIRE
SHOSHONE NATIONAL FOREST
August 20, 1937
SECS. 3, 4, 8, 9, 16, 17 T.51N, R.107W, (Unsurveyed)
Approx Scale - 2½ in. = 1 mi.
Approx Area - 1254.4 Acres
LEGEND
Fire Line
Boundary of Burn
Points where single bodies were found.
Point where Clayton's group was trapped—
Seven bodies found here
Drawn by JWE 9-7-37
Approx
Upper Camp
Elev. 7,200
Creek
Trail
Clayton
First Aid Station
Elev. 7,700
Point of Origin
Rock Pt.
Cr.
Post Pt.
Trail
Ridge
Blackwater
Logging Cr.
Creek
Double Mtn.
Elev. 10,400
Coxcomb Mtn.
Elev. 11,100
To Elk Fork
To Elk Fork



Aerial view of Blackwater burn looking southeast directly up the head of Clayton Creek. Dash line indicates lower boundaries of fire. Dotted line indicates the lost control line. Right-hand arrow shows gulch where Ranger Clayton and seven men were trapped. Left-hand arrow shows open point on ridge where Ranger Post took refuge with his crew.

THE FACTORS AND CIRCUMSTANCES THAT LED TO THE BLACKWATER FIRE TRAGEDY

A. A. Brown

Fire Control, Region 2

Included as a vital part of the full report on the Blackwater Fire was the report made by A. A. Brown after an exhaustive study of the fire behavior and the critical circumstances which converged to bring about the tragedy. Mr. Brown had been only recently transferred to Region 2 to head the fire control work of that Region, and he brought to the tasks involved in this disaster the sound knowledge and discernment springing from long and successful fire experience.

While no proof is available, the nature and circumstances of the blow-up on August 21 seem to indicate that an undiscovered spot fire, probably from the night before, to the north of Clayton Gulch and over the small, sharp ridge in Clayton Creek (one-half mile west and north of the point where the Clayton group was later found), was the first critical factor in making the trap in which the men were caught and burned to death on that day. Apparently this spot fire at first spread up the slope immediately above to the northeast. This is clearly indicated by the note Ranger Clayton sent to Ranger Post at the time the spot fire spread conspicuously just prior to the blow-up.

The second critical circumstance was the fact that the timber above the newly constructed line had not crowned out except for a small fringe along the south edge. The third critical circumstance was the fact that "spotting" from the fire of the previous day had given a ragged edge to the burning area on the steep downhill side, with small spots below the general front. As a result the fire fighters found it expedient to connect the fire line below the hottest spots, leaving considerable unburned surface fuel inside the line at the lowest point.

The fourth critical element was the nature of the forest fuel in this drainage. It consisted of a very dense stagnated stand of Douglas fir with a varying mixture—5 to 15 per cent—of spruce and of alpine fir. A dense overhead canopy existed, with dead branches nearly to the ground, with many small, brushy, dead or nearly dead suppressed trees as an understory, a considerable volume of sound dead branches, logs and suppressed trees on the ground, and with varying amounts of moss throughout the canopy and on all the dead branches. In addition, slopes of 20 to 60 per cent prevailed.

These four factors set the stage for what happened.

The relative humidity at 1 p. m. on August 21 was 6 per cent, with a

temperature of 90 degrees at the fire danger station at the Wapiti CCC camp, two and one-half miles away at 2,000 feet lower elevation. At approximately 3:30 p. m., with these critical circumstances prevailing, a strong gusty wind of apparently at least 30 miles' velocity per hour came up from the southwest. About 3:45 p. m. it swerved and became a west wind. (These times are based on the circumstantial evidence of other events of the fire.)

The duration of this strong velocity is uncertain because of the strong convectional winds set up almost at once by the crowning. It is reasonable to suppose that the change in direction may have been largely a convectional effect. At the start, timber began to crown above the line and the whole fire there began to pick up in intensity and to throw new spots below the line, as might be expected. Possibly this exerted a strong convectional pull on the spot fire below, which had also begun to crown.

At any rate, the course of the drive from the spot fire changed to the east and started directly up the drainage. The two crown fires then rapidly closed together with the cyclonic effect of such a circumstance, which reached its climax at 4:20 p. m. As a result, the major portion of the head of the Clayton Creek drainage from the spot fire up to Double Mountain was swept clean in a final crown fire conflagration which was completed by approximately 5 p. m.

In this conflagration 9 deaths occurred directly. Six additional men were so badly burned that death ensued, and 36 additional men suffered injuries from which they are recovering.

Just before the crowning started, the distribution of men on the newly constructed line in Clayton Creek had been as follows: Five men of the National Park Service crew on mop-up were operating as far as the first small park, about 5 chains northeast of the ridge. Beyond them for 30 chains were 6 men of the BPR crew, who had been actively pushing the new line construction from this point on, and who had got as far as Clayton Gulch, plus a few men who had been dropped off from Post's crew. Beyond them were Ranger Post, with Foremen Tyrrell and Saban and sub-foreman Hale, with about 40 men who had taken up the new line at Clayton Gulch and had completed 16 chains at the time the blow-up occurred.

Clayton, who had been placed in charge as sector boss of the new construction, was following the fresh crew in and checking up on conditions as he went. Apparently he was checking particularly on spot fires. The BPR crew were giving most of their attention to spot fires at two points

below the 30 chains of line they had constructed. They were about 20 chains in from Trail Ridge, except for Pierce, one of their members who had been left alone on hot line at a point about 10 chains in, where several logs were on fire close to the fire trench. Two men were left to help him as Post's crew came past and about 6 men were left with Saban and Clayton to work on spot fires.

By the time this distribution was completed, about 3:45 p. m., Post, Clayton, and Fifield, probably simultaneously, saw evidence of an uncontrolled spot fire. Fifield, according to his statement, was on the rock point of Trail Ridge at the time and thought at first that it was the spot near the bottom of the first gulch which had previously been found and trenched, but discovered instead that it was in line with it, but over the small ridge just to the north. He at once gave thought to Wolcott's crew, who were in this vicinity, but found them coming out on account of the crowning there. Wolcott immediately went on up Trail Ridge and also called out the men from the fire trail north of Trail Ridge. Pierce, who had been near the highest point of the fire trail before it dipped down into Clayton Gulch, had already come out to the first small park with the two CCC boys helping him because of a flash of crowning just below him, which apparently crossed the fire line but died down again at the little park. He attempted to get the attention of the rest of the BPR crew, but, receiving no answer, decided they were withdrawing the other way.

About 6 other CCC boys were also assembled at the park, and all came out together at Wolcott's alarm call. The heavy crowning apparently occurred shortly afterward (about 4 p. m.). Post's attention was attracted to the spot fire when it started crowning toward the northeast up the slope on the north side of Clayton Creek. His first thought was to take his crew to it, but the wind changed and the fire started up the gulch before he could take any action to that end. Accordingly he started moving his crew from its path as best he could, as described in his statement.

Clayton's movements are not so clear in detail. It is evident from the note he dispatched to Post that the spot fire had attracted his attention, apparenly from on the spur ridge just south of the gulch, where he was later trapped. Up to the time this fire started directly up the gulch it was a threat to the line above which must be stopped, but probably did not appear to be dangerous to life. Clayton saw it was the focal point if the line were to be held, and that more men than the 7 with him would be required.

It does not seem likely that he waited on the ridge above Clayton Gulch the 20 minutes or more that seems to have elapsed from the first active

spreading of the spot fire below until the general blow-up occurred. Probably he started down toward it, either with his group or alone. If alone, he probably left instructions for his group to await his investigation of potentialities below. Or, if he took his group, he probably left one or more men at the spring in the gulch to await reinforcements from Post. In either case, the natural route of travel toward the spot fire would be down the gulch toward it.

Once off the ridge the full potentialities of the fire below would not have been immediately as evident to him as it was to Post above. Presumably, as soon as he saw what was about to happen, he turned back to get the men at the spring. In doing so he had to go back up the slope ahead of the fire and probably got to his men just at the time that every avenue of escape was cut off. Had the fire been going across topography the bare gulch might have served satisfactorily as a refuge. With the direction of its path directly up the gulch, it probably acted as a furnace draft and became a death trap.

In conclusion, the reconstructed tragedy depended on each of the four factors first discussed which contributed to the behavior of the fire, plus the distribution and movement of the men at the time. The high wind and burning conditions alone, without the spot fire, would have created a dangerous situation, and would have no doubt forced abandonment of the newly constructed fire line, but without loss of life, since distances to safety were not great. Exactly the same strategy employed would likely have succeeded without incident a few hours earlier, or perhaps even at that time of day if no sudden change in wind velocity or direction had occurred.

Had the spot fire not been in line with one already controlled, or had not been hidden by the sharp little ridge in the bottom of Clayton Creek, it would have had earlier attention from the Park crew from Trail Ridge, and again the situation would have been changed.

More time on the part of either Clayton or Post to fully scout out the potentialities of the fire ahead of the crews might have prevented the tragedy.

Earlier arrival of the new crew, even by as little as a half hour, would have resulted in completing the new line and would have concentrated the attention of all supervising officers and man-power on all threats to holding it. This would have resulted in a different distribution of the crews and probably slight danger. Many other premises may also be drawn, but the matter of timing of action of the fire vs. movement of men gave the distinctive and fatal combination.

C. C. C. DETERMINATION

John Sieker

Supervisor, Shoshone National Forest

One bright memory in the midst of all the tragedy surrounding the Blackwater Fire was the response of the CCC crews the morning following the blow-up.

Naturally, all fire suppression work had ceased during the night. All available foremen and men were on searching parties looking for injured men. At daylight a 150-man crew was again out searching for any that might have been missed during the night, and arranging for removal of the dead. But tragedy or not, there was still 1,200 acres of fire running around loose, and the humidity was below 10. Scouting and line construction had to be done, and there were only tired, depressed men left to do it.

The CCC men rose to the occasion like veterans, and at daylight three crews were on the fire line carrying on—determined to whip the fire that had beaten them so terribly the afternoon before. These boys put through difficult line that day and held it through a very critical afternoon. Most of them had seen horrible burns the night before, and many saw corpses packed out during the day, but they did not let that deter them in their attack on a stubborn fire.

The CCC responded to an emergency in a very noble and courageous manner, and the Shoshone and the entire Forest Service appreciate it.

CALCIUM CHLORIDE AS A FIRE RETARDANT IN GROUND LITTER

MORRIS FRAM

Junior Engineer, Region 5

Calcium chloride is so strongly hygroscopic that it will often go into solution with moisture absorbed from the air. This property is sometimes used to keep dirt roads wetted down permanently, and it seems possible to wet down beds of ground litter effectively by spreading a line of these crystals in advance of an approching ground fire. Though these properties of calcium chloride are known, the time required for the salt to go into an effective solution with moisture taken from the air and wet down a bed of litter or brush under summer conditions and its practicability in fire fighting remain to be determined.

Some preliminary tests of this form of wetting down ground litter were made at Cuyama Ranger Station, Los Padres National Forest, on May 13, 1937, and it was found that if allowed to act overnight the application was effective, but that it was not effective if allowed to stand for only a short time during the heat of a dry day. In conducting these tests, usual ground conditions under pine trees were duplicated as far as possible. The litter was carefully laid about two inches deep, the calcium chloride sifted over it uniformly, and the plot allowed to stand until it was ignited.

To get a definite comparison between the burning action of the litter when treated and untreated, each plot had next to it a similar but untreated plot which was ignited at the same time and which, therefore, burned under the same conditions. For economy in building plots, the untreated control was made with a treated one on each side, thus acting as a comparison for two tests run at once. The three were in line, ignited together, and gave data for two tests at once. To restrict the size of the plot and to achieve uniformity, they were built inside a standard framework of pipe four feet square and ignition was made by pouring a thin line of gasoline to the windward side of each and touching it off.

Because certain applications of the salt definitely retarded the fire by reducing but not stopping its rate of spread, the effect of the application was judged by the rate of spread of the fire over the treated in comparison with the untreated plot. If the untreated plot burned over its entire area while the adjacent plot, with the calcium chloride, progressed only 40 per cent of its area, it was said that the rate of spread of the fire was reduced to 40 per cent. With the heavier applications, the treated area would support

no flame whatever; therefore, it was said that the rate of spread was reduced to 0 per cent. In the very light applications where the salt had no measurable effect the rate of spread of the treated fire was said to be 100 per cent. The values were judged by eye as nearly as possible, and are shown in the following table and graph.

In the first series of tests run the technical grade salt containing 30 per cent moisture was allowed to remain on the bed of litter for an overnight period. On the following morning, May 13, 1937, at 8 a. m., the test was started. The weather was clear, temperature 79 degrees F., relative humidity 43 per cent, with practically no breeze. The following is a summary of the overnight application tests:

Quantity CaCl Applied		Fire Reduced to (Speed) Per Cent	Remarks
Total Pounds	Pounds Per Sq. Ft.		
¼	0.016	100 (no effect)	
½	.032	100	
1	.063	100	
2	.125	100	
4	.250	40	Did not burn in the center at all
6	.375	30	Did not burn in the center at all
8	.500	0 (stopped fire)	Burned only at outer edges
10	.625	0 (stopped fire)	Burned only at outer edges

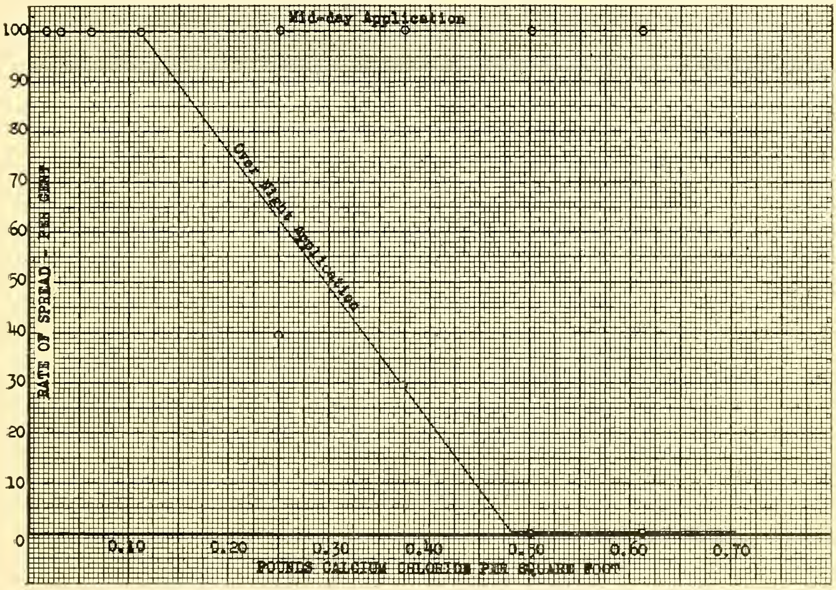
The same results are illustrated in the graph on the following page. The litter was damp where the calcium chloride crystals had been in contact with it, but in the case of the heavier applications the calcium chloride seemed to form a crust with the moisture it absorbed, which protected the crystals from going further into solution and also seemed to be effective in protecting the fuel from the fire.

Another similar series of tests were run during the heat of the day to determine if an application would be effective if allowed to stand during the hotter and drier hours. The result in this case was entirely negative. On May 13, 1937, application of the salt was made on litter beds at 11:30 a. m., when the temperature rose to 87 degrees F. and the relative humidity was 29 per cent. It was allowed to stand 4¼ hours, or until 3:45 p. m., when the temperature was 91 degrees F., relative humidity 27 per cent, weather clear and breezy. At the time it was ignited, no sign of the salt going into solution could be observed, and the only effect, if any, seemed to be the smothering effect similar to an equal amount of dirt. A study of graphs, marked Fig. 1, 3, and 4, included in this report, indicates that the salt was theoretically at the point of going into solution under the midday conditions, but the dampening action may have been taking place too

FIRE RETARDENT EFFECT OF CALCIUM CHLORIDE ON PINE LITTER

Litter 2" deep
Calcium Chloride contained 30% moisture
Cuyama Ranger Station
May 13, 1937

F. W. Funke, Project Leader
J. Allen
M. Fram



slowly. This is because, in general, the conditions during midday are such that even if the salt would go into solution, the very low difference in vapor pressures between the solution and the air would require the action to take place very slowly. This can be noted from the graph of vapor pressures, as illustrated in Fig. 4. On the other hand, once the fuel is dampened with a solution, either applied as such or applied as a salt and allowed to go into solution with moisture taken from the air, drying out, due either to the weather conditions met during a hot, dry day, or to an approaching fire, would be very much slower than drying out of plain water.

No other claims can be made for calcium chloride in fire fighting, but from its property to take moisture from the air, moisten fuel, and hold the moisture under dry conditions, this salt and its solution seem to show some promise if applied under certain conditions. What these conditions are, what exact quantities are required, method of application, and whether the whole thing is worth while must be determined by further tests under conditions found in the field on going fires.

It seems entirely probable that on large fires where man-power is insufficient to build control lines, the pre-treatment of selected areas with calcium chloride well in advance of the fire will create an effective barrier which will definitely retard the advance of the fire. Under favorable conditions it will check the spread of ground fires.

It should be pointed out that there is a very definite relation between relative humidity and the amount of moisture which will be absorbed by the chloride. At first glance it might not seem worth while to consider an agent which is active only when rate of spread or inflammability is low, but there are many instances on every large fire when the humidity is sufficiently high to make a chemical of this type effective. Once having absorbed enough moisture to go into solution, the liquid will maintain a reasonably moist condition in litter under quite high temperatures and low humidity conditions.

The information which is here passed on to the field is an abstract of data developed as an incident to the Aerial Fire Control Project work in the California Region. There is little which is conclusive, but there is a suggestion which it is felt will have application once the technique has been developed. It is hoped that the data will form the basis for further experimentation by interested agencies to determine the practicability of such applications.

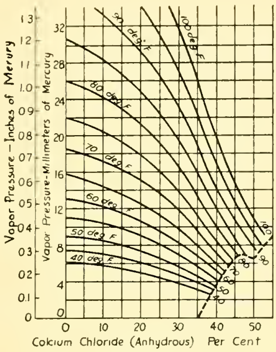


FIG 1. VAPOR PRESSURE OF CALCIUM CHLORIDE SOLUTIONS

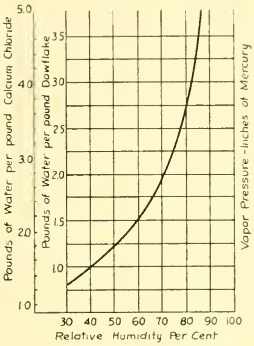


FIG. 2. WATER CONTENT OF CALCIUM CHLORIDE SOLUTIONS FOR VARYING RELATIVE HUMIDITIES

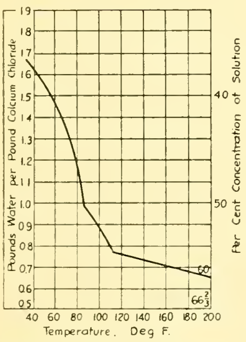


FIG 3. CONCENTRATION OF SATURATED CALCIUM CHLORIDE SOLUTIONS FOR VARYING TEMPERATURES.

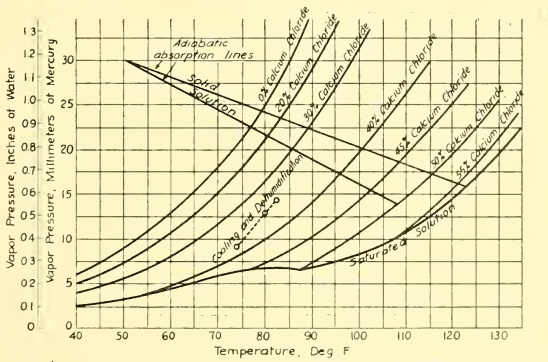


FIG 4. VAPOR PRESSURE OF CALCIUM CHLORIDE FOR DIFFERENT TEMPERATURES

EXPENDITURES PER ACRE FOR PREVENTION AND PRESUPPRESSION

National Forest and Private Land Inside Boundaries

(Protection Boundaries R-7, 8 and 9)

DIVISION OF FIRE CONTROL

Washington

The cost per acre of fire control includes (1) direct expenditures and (2) cost adjustments. Cost adjustments include maintenance and depreciation on fire control improvements; a proper share of maintenance and depreciation of improvements used by other activities as well as fire control; depreciation on fire control equipment, and the value of CCC and similar labor where such expenses are not paid from allotments to the Forest Service. Cost adjustments for FY 1937 (ending June 30, 1937) are not yet available. In the following table expenditures only are compared for fiscal years 1936 and 1937. The 1936 figures are the same as on page 224, April FIRE CONTROL NOTES, except that a correction in area protected that year in Region 9 has changed the figures for that Region. Note that suppression expenditures are omitted from the table.

REGION	PREVENTION F. Y. 1936	PREVENTION F. Y. 1937	PRESUPPRESSION F. Y. 1936	PRESUPPRESSION F. Y. 1937	TOTAL F. Y. 1936	TOTAL F. Y. 1937
1	.004	.0026	.026	.0365	.030	.0391
5	.010	.0098	.024	.0375	.034	.0473
6	.003	.0042	.021	.0294	.024	.0336
2	.001	.0008	.002	.0043	.003	.0051
3	.000	.0003	.004	.0070	.004	.0073
4	.000	.0008	.006	.0111	.006	.0119
7	.009	.0129	.021	.0380	.030	.0509
8	.006	.0105	.023	.0222	.029	.0327
9	.007	.0057	.028	.0511	.035	.0568

RULE OF THUMB FOR DETERMINING RATE OF SPREAD

J. A. Mitchell

Lake States Experiment Station

To determine the approximate rate of spread of a fire in terms of perimeter increase, multiply the rate at which the head of the fire is advancing by *three.*

Example: If the head of a fire is advancing at the rate of 5 chains per hour (5.5 feet per min.), the rate of spread is approximately 3 times 5 or 15 chains per hour.

The same result may be secured by: (1) *Multiplying* the number of feet the head of a fire advances in 10 minutes by *.27;* or (2) *Dividing 180* by the number of minutes required for the head of a fire to advance 1 chain.

The above rules are based on the mathematical relationship of the diameter of circles to their perimeter ($d\pi = p$) and the fact that fires spread primarily in one direction. Three is used instead of π or 3.1416 to simplify computation and because fires tend to be oval or egg-shaped rather than circular after the first few minutes, thus reducing the ratio between perimeter and diameter as measured on the long axis. If fires spread equally in all directions, the relationship of advance of front to increase in perimeter would be expressed by 2π or 6.2432. This condition, however, rarely prevails, since advance of front against the wind is usually negligible. On the other hand, the ratio of advance of head to perimeter increase in the case of long, narrow fires tends to approach 2.

While the rule of three given above for computing rate of spread is obviously not precise, it offers a ready means of determining on the ground the approximate rate at which line must be constructed in order to bring a fire under control.

The following table shows, for various rates of advance of front, the corresponding rate of spread or perimeter increase in chains per hour as determined by the rule in question:

Rate of Spread (Perimeter Increase) in Chains per Hour in Relation to Advance of Front

Advance of Front Feet in 10 Minutes	Advance in Front Minutes per Chain	Rate of Spread Chains per Hour*	Rate of Spread Chains per Hour*
5	1	1	180
10	2	3	90
15	3	4	60
20	4	5	45
25	5	7	36
30	6	8	30
35	7	10	26
40	8	11	23
45	9	12	20
50	10	14	18
55	11	15	16
60	12	16	15
65	13	18	14
70	14	19	13
75	15	20	12
80	16	22	11
85	17	23	11
90	18	25	10
95	19	26	9
100	20	27	6

*Rounded off to nearest chain.

Locating Radio Sets Visually—As the "S" sets are mainly used intervisibly, there are times when the exact location of one or both of the two sets needs to be known. This is especially true in the search for small fires in broken country where the lookout stations may direct the searching party, provided their exact locations are known to the observer. The Trinity Forest, after utilizing fruit tins, eyeglasses, white shirts and other paraphernalia of the average fire crew, solved the problem by inserting a metal trench mirror in the cover of the sets. The mirror is recessed flush in the wood and has a ¼-inch hole bored in the center and through the wood cover. In use, a spot is picked out where the station to be flashed can be seen. Then a twig is found in line with the station and the mirror. By flashing on the twig and keeping the shadow on the twig's end, the other station can be lined up in the same manner as used in the heliograph method. Use of the mirror does away to a great extent with the necessity for radio standby on lookouts in order to contact traveling officers who flash in the observers as desired. Obviously, an extra mirror to be used when flashing in the direction of the sun's rays is desirable.—*George Buxton, Administrative Assistant, Trinity National Forest.*

FUEL CONTAINER FOR PORTABLE PUMPERS

K. M. MacDonald

Fire Assistant, Nicolet National Forest

Two fuel containers of the type shown below were constructed and put into use three years ago on the Argonne District of the Nicolet. They have been used continuously since that time and as yet show no appreciable signs of wear or damage.

These containers were constructed because no can or container commercially available met the need for a strong, leak-proof fuel container of a shape and size suitable for use in connection with portable pumpers.

The cans are of sufficiently heavy material so that danger of their being cut or dented is minimized. The riveted and soldered construction largely precludes the probability that leaks will develop at the seams. The handle, filling hole, and spout are protected, yet no damage will result if tools, boxes, or other equipment are piled on top of the cans. Because of its flat shape, this container may be carried in the hand much more readily than a round can of equal or smaller capacity. The flat shape also lends itself admirably to back packing or horse packing, where this is necessary.

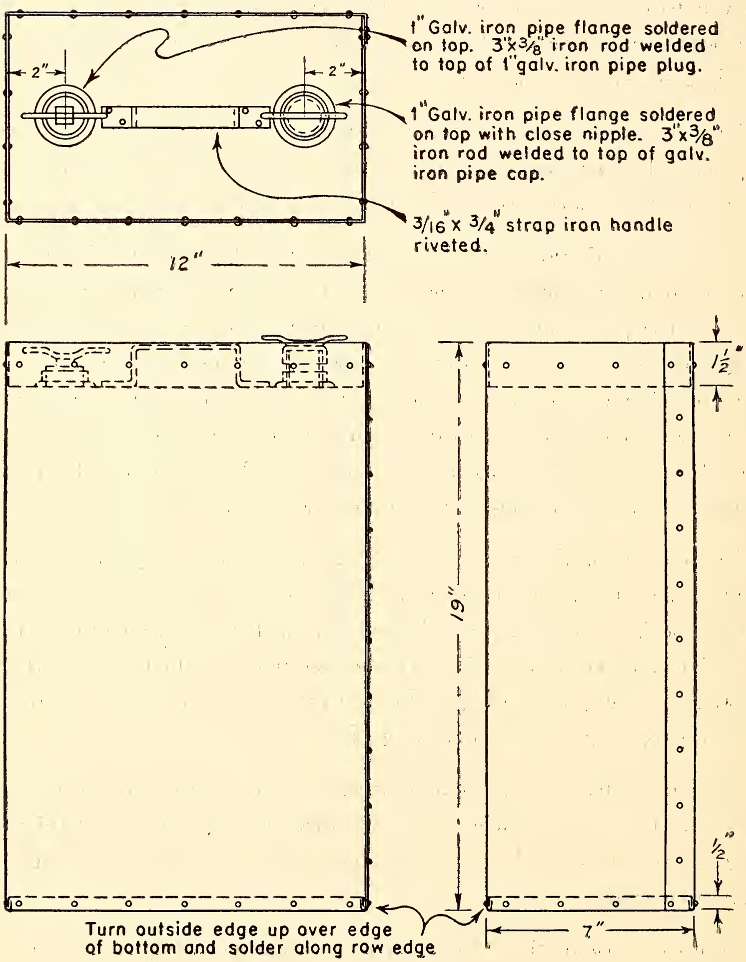
The capacity of the cans is such that five gallons of gasoline, with oil added at the rate of one and one-half pints per gallon of gasoline (Pacific-Marine specifications for types N and Y), will fill it to all practical purposes. No damage will be done to the pumper beyond minor fouling of the plugs if five gallons of gasoline are put in the can and the can filled with the proper grade of lubricating oil.

If one is contemplating back packing such a can of pumper fuel, it is interesting to note that when the can filled with gasoline and oil in the proper proportions is lashed on a pack board the entire outfit will weigh very nearly 50 pounds.

The initial cost of this kind of a fuel container will probably be from two and one-half to three times as great as for ordinary round five-gallon cans. However, the life of the container may reasonably be expected to be in the same ratio to the life of ordinary round five-gallon cans.

FUEL CONTAINER FOR PORTABLE PUMPERS

Construct from 24 gauge galvanized sheet. All seams to be soldered and riveted every 2" along seam and within 1" of the end of every seam or corner.



QUESTIONS AND ANSWERS

The Questions and Answers Column, which made its first appearance on page 295 of the August issue, has not stimulated the hoped-for response. Here, however, answers are offered to Questions 3 and 4, referring to the training of fire dispatchers. They are submitted by J. W. Farrell, Division of Timber Management, Region 4.

Answer to Question 3:

It is possible to a degree to develop superintelligent fire dispatchers. Surely intensive training and diversified fire control experience will develop the average man, but I question whether it is possible or practical to develop a man who can perform adequate fire dispatching at all times and under all conditions without weighing the many variable factors. The progressive and successful fire dispatcher must search for new ways and means to gauge fire weather and fire behavior, and he must study fuel types and have an outline of available man-power.

The dispatcher needs training and experience, but he also needs the best guides available to supplement his judgment.

I believe the tendency is to overlook the fact that the fire dispatcher in many instances performs his work by steps. The initial attack and the follow-up with reinforcements are largely based upon the information furnished from time to time by the party reporting the fire. In many instances follow-up action is prompted by the reports of the lookouts. The fire dispatcher should be able to study the behavior and possible spread of the fire through the lookouts or others who are reporting the fire.

Answer to Question 4:

A. Basic factors to consider:
   1. Probability of occurrence of fires—lightning, man-caused fires.
   2. Fuel type—rate of spread, resistance to control.
   3. Topography and exposure.
   4. Wind.
   5. Fuel moisture content.
   6. Type or character of suppression forces available.
   7. Transportation facilities.
   8. Visibility.

B. How obtained:
   1. By entering on maps areas of high risk—sawmills, logging operations, recreationists.

2. Accurate fuel type maps.
3. Considered as a part of fuel type mapping.
4. Half and two-inch wood cylinder records.
5. By building up lists of available man-power and by intensive training of organized crews and sufficient overhead.
6. Maps and charts showing transportation facilities available.
7. By providing visibility maps based upon systematic field surveys.
8. By preparation of guide charts.

C. All information should be shown on maps or on charts condensed to the absolute minimum. We should use care that maps, charts, and records are not too intricate and do not prove a burden to the dispatcher rather than a help.

Marking Fire Trails for Night Use—Crater Lake National Park rangers have developed a novel method of marking obscure unsigned fire trails by means of reflector buttons at the edge of truck trails. The method used is as follows:

To a 1 × 4 × 4-inch block of wood are fastened a number of ¾-inch reflector buttons, such as are used on highway warning signs. A hole is bored through each block for driving a nail. These blocks are fastened to trees at the road edge low enough so that the lights of fire trucks will pick them up.

The fire trucks carry extra blocks with buttons attached so that one can be left on the road edge when the first crew leaves the road for a fire, and along the route to the fire if off the trails, so that other crews can follow up.

A modification of this method would be to use a different number of buttons on the blocks (a smaller one would do) to indicate readily each of several trails which may leave a truck trail.—*L. F. Cook, Deputy Chief Forester, National Park Service.*

TIME SPACE SCALE, AN AID TO TRANSPORTATION PLANNING

Karl E. Moessner

Junior Forester, Upper Michigan National Forest

Coverage overlays necessary in transportation planning are easily and accurately plotted by means of an adapted Humphrey Time Space Scale[1] and a Chartometer[2].

When adapted for Forest Service use the scale consists of two main parts (illustration No. 1).

1. *A Space Scale*—graduated in miles and quarter miles and reading zero to ten miles at the scale of the map to be used for transportation planning.

2. *A Time Scale*—placed directly below the space scale with zero line corresponding, graduated in minutes and reading time required to travel from zero to ten miles.

By placing the time scale for all kinds of transportation equipment likely to be utilized on one composite scale (see illustration No. 2) the time required to travel any distance up to 10 miles over any type of road, by any kind of vehicle, appears in minutes directly below the distance traveled; and conversely the distance possible to travel appears directly above the time available. By making the time space scale agree with the scale of the map used, the planner is able to lay off directly, with a chartometer, the available minutes of travel time.

The following problem illustrates the method used in plotting coverage by means of a time space scale.

Problem—To plot the limits of the fifteen-minute coverage zone from Center No. 1 East along highway and connecting truck trails and roads (illustration No. 3). All travel on roads to be in ½-ton pickup, cross-country travel to be on foot.

Procedure 1—Set the map measurer at zero. Place it directly over the zero line on the time scale (illustration No. 4, Point A) and run the measurer *forward* until directly over the fifteen-minute point (B).

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[1]This scale, a familiar item in Correspondence Courses of the U. S. Army War College, indicates time in minutes necessary to travel a known distance at a given rate, and is used by the officer as an aid in building up transportation schedules for units considered in theoretical military situations.

[2]The Chartometer, or map measure, is an instrument consisting of a small wheel geared to a pointer on a graduated face. As the wheel is run over a road on the map, the pointer registers map inches traversed. This instrument is especially valuable for use on crooked roads or trails.

2. Without moving the pointer, place the instrument on the map directly opposite Center No. 1 (illustration No. 3) at point A. Run the measurer *backward* along the highway until the pointer reads zero (B) and mark this point. It is the limit of the fifteen-minute zone along the highway.

3. Determine the travel time to the intersection of truck trail and highway by running the measurer *forward* on the map (illustration No. 3) from point A to point C, then *backward* on the scale (illustration No. 4) points A to C and indicate time, two minutes, at the intersection. In like manner indicate time at points D and B.

4. To run out the zone limit on a tributary road, set the measurer on zero, place it on truck trail scale (illustration No. 4) at two-minute mark (point C) and run forward to the fifteen-minute mark (point E). Then place the measurer on the map at the intersection of the roads (illustration No. 3, point C) and run it *backward* along the truck trail until the pointer reads zero at E. This point will be the limit of the zone on the truck trail. All points on secondary roads or trails are run out in like manner.

5. To indicate cross-country travel at intermediate points, indicate time to points as at F (illustration No. 3) and lay off balance of time by means of a compass set from Foot Travel Scale as F to 1 (illustration No. 4).

6. Connect all points marked as extremities of fifteen minutes in order to sketch outline of fifteen-minute coverage from Center No. 1.

7. Along straight roads, lay the scale directly on the map with edge parallel to the road, and mark points direct. On crooked roads the map measurer is faster and more accurate.

While the above procedure has been explained in detail as an illustration, in using this technique the planner should keep the requirements of his job in mind. The accuracy and detail necessary on a map to be used by a dispatcher is seldom justifiable in a general transportation plan of a forest. The technique, however, is flexible, and the planner should use such short cuts as are expedient in accomplishing his objective.

The adapted time space scale used in this article is a local table. It utilizes averages from road tests conducted on the Upper Michigan Forest only, and cannot be assumed to represent true averages for the region or country as a whole. Furthermore, all tests were made by equipment driven within the CCC speed limits, and might not apply should this agency

cease to exist. The following description covers the steps necessary in adapting the scale, and may prove of value to any forest desiring to construct a table for its own use.

1. Classify all roads on the forest. This may be done by inspection, by actual driving tests or by any other feasible manner, but should result in a number of classes, such as Highway, Truck Trails, Rut Roads, etc., which may be further broken down into First, Second, and Third class.

2. Make road tests, over stretches of not less than five miles, on a number of roads in each class, using all types of equipment likely to be utilized for fire transportation purposes, and taking data in minutes for the course.

3. Make cross-country tests, using men equipped with standard fire tools, such tests to be over foot trails, through timber, and through swamp, or any other situation pecular to the forest concerned.

4. Average tests by equipment, by road, and by ground conditions, checking averages to determine if sufficient samples have been taken. The figure arrived at should be in minutes for the distance traveled.

5. To build up scale, plot distance in miles (to the scale of the map to be used) across the top of the paper. Indicate the average minutes of travel time directly under the distance traveled. Subdivide the space indicated by the parallel lines method into minutes or multiples of minutes.

Such a scale carefully constructed and backed by adequate field work will be found to be not only an aid to the fire planner, but an indispensable tool to the dispatcher when estimating the travel time factor of the probabilities of a going fire.

DESCRIPTION—This scale consists of:

(a) A ....inch = ... mile scale reading 5 chs. — 10 chs. (1/8 mile) and miles.

(b) A time scale .... = ... mile reading travel time in minutes for various types of equipment over various types of roads.

THE HUMPHREY TIME SPACE SCALE

as adapted for Upper Michigan, showing composite scale for all equipment and roads.

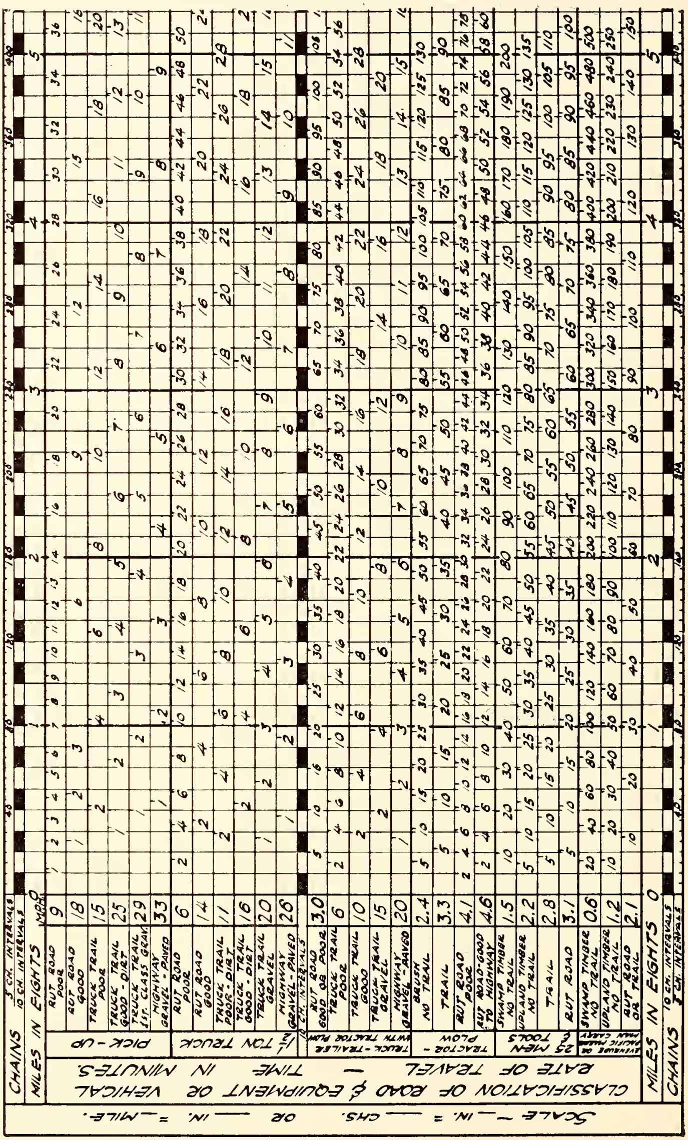


Illustration No. 2

HOW TO USE

(a) Knowing distance and rate of travel—time necessary appears on proper scale directly below the distance.

(b) Knowing equipment and time available. Distance possible to travel appears on mile scale directly above time.

(c) To use over crooked road. Set map measurer at zero and run over road. Then set measurer on zero line of proper scale and run backward until instrument registers zero. Read travel time at this point.

(d) To determine distance covered within given time. Set measurer at zero and run over proper scale until time limit is reached. Then run measurer backward from starting point on road until measurer reads zero.

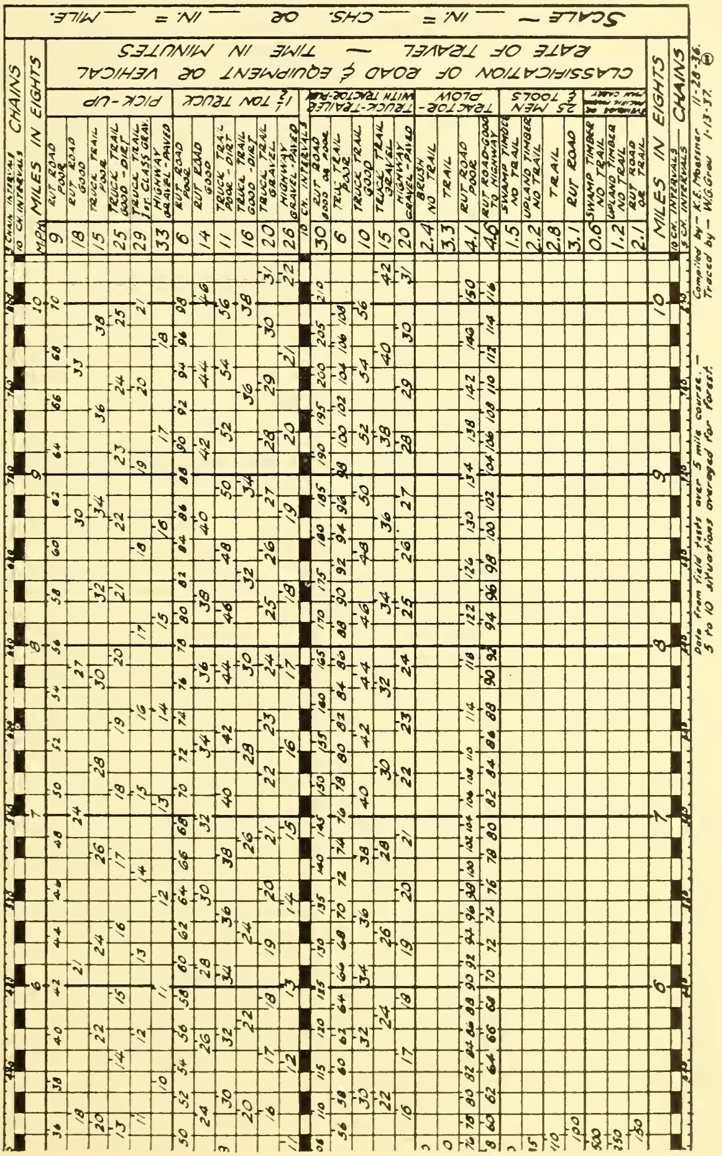
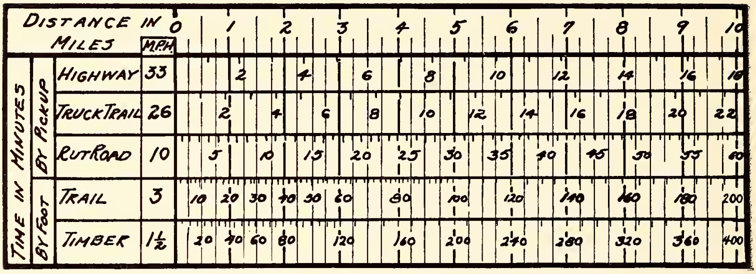


Illustration No 2 (continued)

HUMPHREY TIME SPACE SCALE

Illustration No. 1



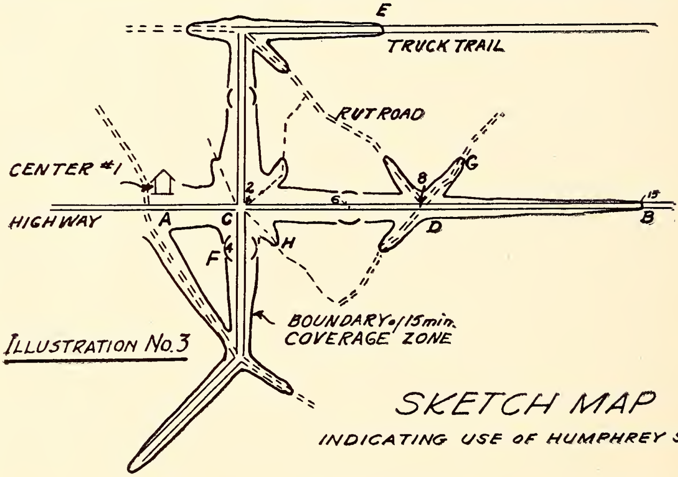
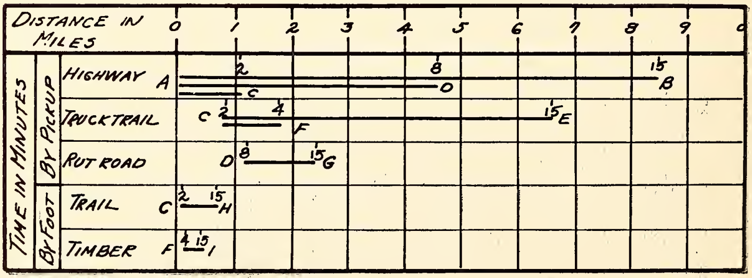


Illustration No. 3

SKETCH MAP

INDICATING USE OF HUMPHREY SCALE

Illustration No. 4



BY KARL E. MOESSNER

DRY ICE AND FOREST FIRES

A. B. Everts

Assistant Forest Supervisor, Cleveland National Forest

The commercial uses of dry ice (CO_2) are many and varied. What is believed to be the first use of this substance as a source of power for water pressure in connection with tank trucks was demonstrated on the Cleveland National Forest early in 1937. The unit employed consists of two 25-pound-capacity converters, a pressure gauge, a live hose reel and hose, and a 50-gallon high-pressure water tank equipped with a safety pressure release valve. The total cost for labor and material was $167.

In use, 25 pounds of dry ice is inserted through an opening in the top of the converter, and the top closed. When the dry ice is thus confined it immediately creates a pressure against the lid which seals the converter. The rise in pressure is very rapid up to 75 pounds, at which point the gas, as it sublimes from the solid, becomes a liquid. When all of the solid is melted the converter contains a liquid on the bottom and gas on top. At 77° temperature a pressure of 933 pounds per square inch will register on the gauge. As gas is withdrawn from the top, enough liquid converts to gas to keep the pressure at 933 pounds until the last drop of liquid is gone.

The pressure in the converter may be stepped down to the desired working pressure by means of a control valve, such as is used on acetylene welding outfits, and carried through a high-pressure hose to the water tank. This pressure then forces the water through the hose line.

The unit, as constructed on the Cleveland Forest, is much heavier than is now believed necessary. The water tank was constructed of quarter-inch boiler plate, electrically welded, and actually tested at a pressure of 1,050 pounds. A safety valve, set to release (or "pop") at 200 pounds pressure, is provided as a safety measure. The converters, uncharged, weigh 96 pounds each. The entire unit, with two fully charged converters, weighs 767 pounds; the weight of the water is 416 pounds, making a total of 1,183 pounds. By using a lighter water tank, hose reel, and converter the weight could be greatly reduced. The metal boxes for carrying fire tools could also be eliminated.

The most suitable type of converter which has been brought to the writer's attention is manufactured by a Chicago firm at a cost of $30 apiece. A double battery of these weighs 195 pounds when fully charged. These have actually been tested at a pressure of 7,900 pounds, and are equipped with safety discs which blow at a pressure of 2,800 pounds.

We are purchasing dry ice at 3 cents per pound. Twenty-five pounds will discharge a 50-gallon tank from 7 to 10 times, depending upon the pressure used and the size of the nozzle opening.

At 100 pounds steady pressure the water tank was discharged in two and one-half minutes through a one-quarter-inch tip, throwing the water a distance of 60 feet. At the same pressure, but by using a nozzle with a one-eighth-inch opening, it took 9 minutes to completely discharge the tank. Our experiments have convinced us that 100 pounds of pressure is sufficient to discharge a unit of this size and produce a satisfactory stream for general use. It would seem, therefore, that a water tank capable of withstanding a working pressure of 200 pounds per square inch would be all that is required. The safety valve should be set to pop at 100 pounds pressure.

At this point we would like to emphasize the need for care in distinguishing between "working pressure" and pressure as it is commonly used. As an example: a railroad fitting, ells, tees, nipples, etc., are rated at 350 pounds working pressure, and can be used safely at such load, but are actually tested and rated at 2,200 pounds hydrostatic pressure. I. C. C. container specifications or reference to local Safety Commission requirements for such containers will usually provide satisfactory data for construction purposes.

At the present time several firms are manufacturing a CO_2 type of fire extinguisher. The principle involved in these extinguishers is as follows: CO_2 gas is forced into a high-pressure cylinder. The action that takes place in the cylinder is identical with that which takes place in the converter in which dry ice is used. Liquid is formed in the bottom of the cylinder and gas on top. An inside tube extends from the release valve down into the liquid, and when the valve is opened the gas on top forces out the liquid, sometimes called "dry-ice-snow." This "snow" is spread or "fogged" by a funnel-like nozzle, and is one of the best fire extinguishing agents known. The cost, locally, to recharge these cylinders is $4.75. When dry ice is used the recharging costs but 75 cents. Thus, by equipping the converters with inside tubes and another set of valves, one would have an effective device for extinguishing gasoline and oil fires, as well as forest fires.

Among the advantages of this unit over the regular tank trucks are:

1. Its low cost.

2. Portability—the unit is constructed on an angle-iron framework, and can be carried on stake-sides, dump trucks, or pick-ups.

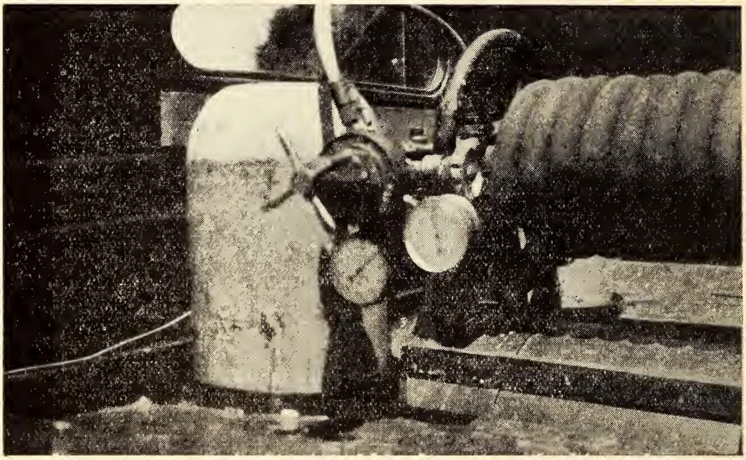
3. Since no power is furnished from the engine, the water does not cease to flow when gears are being shifted, such as is the case with pumps which are operated by a power take-off from the motor.

Some disadvantages are: With two converters, after from 14 to 20 tanks have been discharged (700 to 1,000 gallons), more dry ic is required. Also, tanks must be gravity filled, as the drafting problem has not as yet been completely solved.

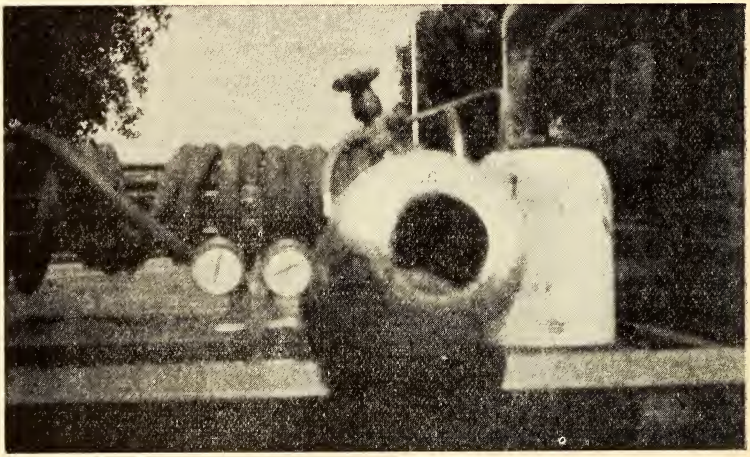
This type of equipment should be quite effective for logging operations. The unit, built on a speeder or trailer, would be ready for instant call without tying up motorized equipment.

The potential value of equipment of this type is obvious when one considers the cost factor and flexibility of use. Units of this type are comparatively inexpensive, and provide a means by which any available motor vehicle can be converted to an initial action tank truck. While we have not had sufficient opportunity to test the unit under all conditions, our limited experience indicates that the development is sound and practicable for field use.

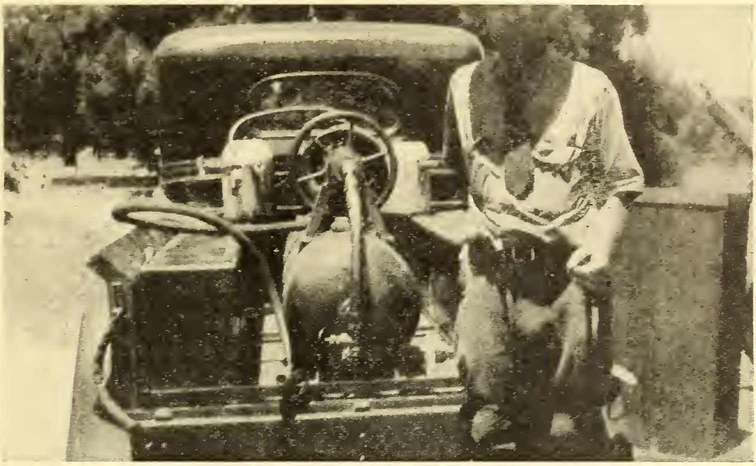
Further experimentation will be carried on to explore the field, and it appears quite certain that a practicable and safe unit will be available for general use within the next few months. As soon as detailed constructional information is ready for distribution, it probably will be issued through Fire Control Notes. For the present, pending conclusion of our experiment, we wish to leave with the field the thought that while the unit still is somewhat in the laboratory stage, a useable piece of equipment is in prospect, and it will be our pleasure to furnish interested agencies with constructional and operating data.



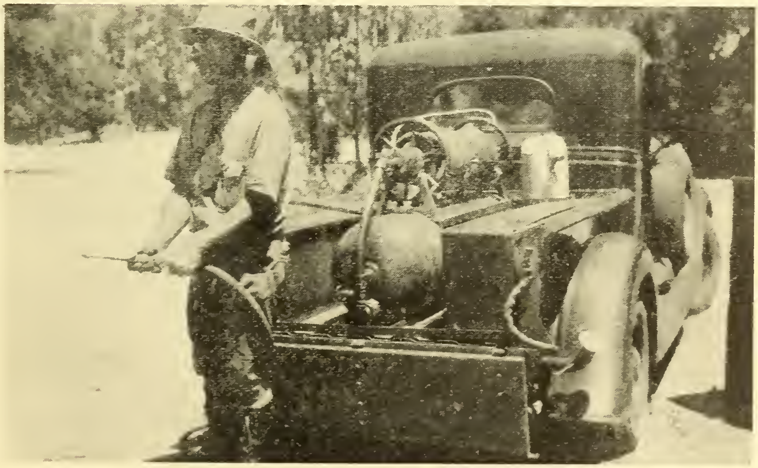
Close-up view of converter, gauge, and live reel hose. The gauge on the right registers the pressure in the converter, while the left gauge registers the "working pressure," or the pressure at which the water is forced from the water tank.



Close-up of empty converter, showing opening through which dry ice is inserted in recharging



View of the unit, constructed on angle-iron framework, inserted in truck body of a pick-up.



Water being discharged from the tank. Only one man is required to operate the unit. When the tank is empty, and the hose line shut off at the nozzle, gas ceases to flow into the empty water tank.

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and that no paragraphs be broken over to the next page.

The title of the article should be typed in capitals at top of first page, and immediately underneath it should appear the author's name, position and unit.

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually directly following the first reference to the illustration.

(OAKLAND-12-6-37-6,000)